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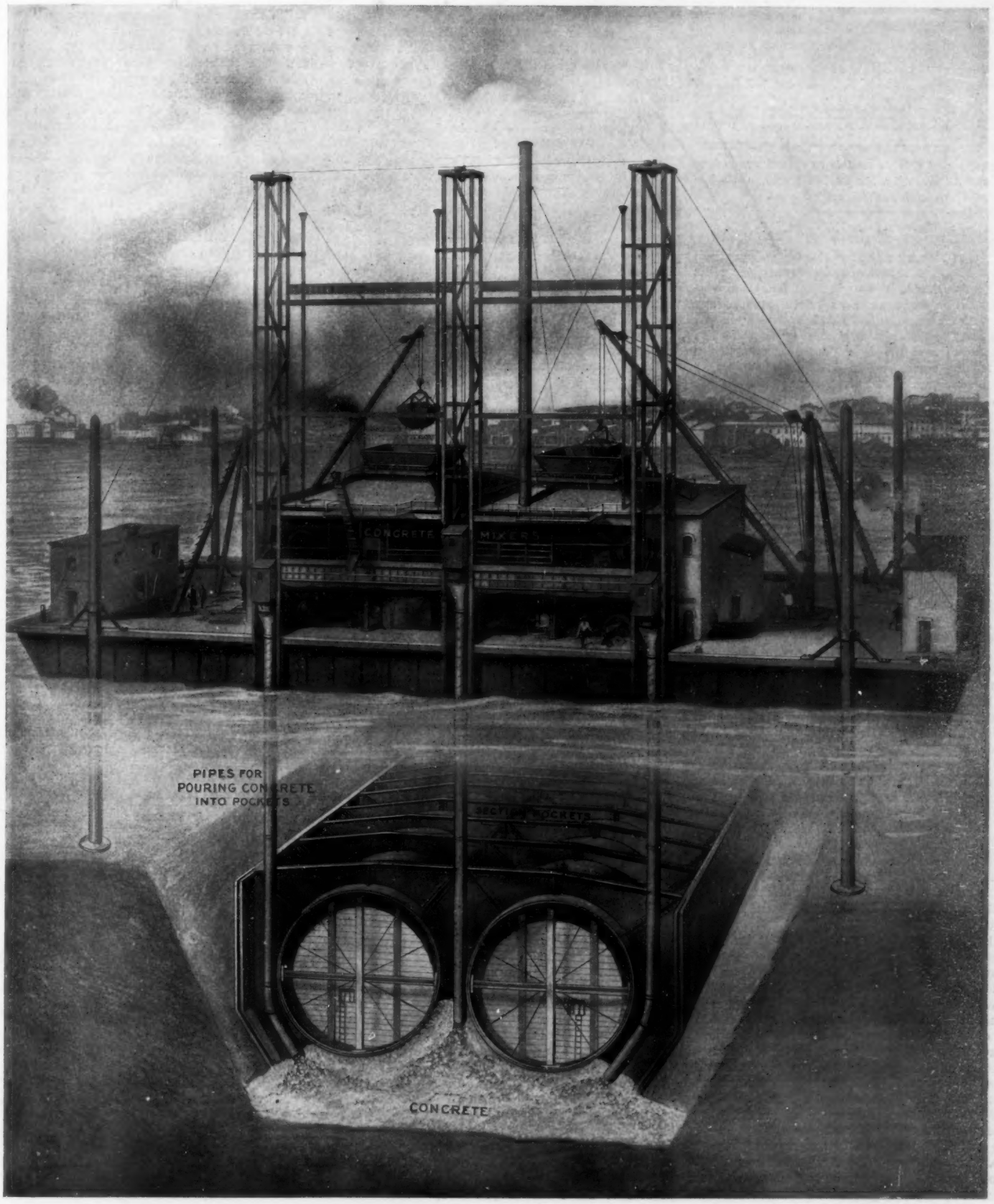

This drawing shows the general method by which the four-track tunnel of the new Lexington Avenue subway of New York will be constructed beneath the Harlem River.

TRENCH-AND-TUBE METHOD OF CONSTRUCTING SUB-AQUEOUS TUNNELS.—[See page 286.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Reorganization of the Navy Personnel

ONE of the most urgent needs of the Navy at the present time is a thorough reorganization of its personnel. To be convinced of this, let us consider a few of the basic facts which underlie any efficient military organization, naval or otherwise.

In a naval establishment there must be sufficient men and officers to man the fleet. Twice as many ships would require approximately double the number of personnel. In other words, there should be a definite relation between the tonnage and the personnel. Axiomatic as this fact is, the present conditions do not recognize it.

Having arrived at the definite number of officers needed, it is then necessary to distribute them in proper proportions in the different grades. A single battleship requires but one captain; yet about forty junior officers are necessary to carry on the duties of the ship. Not only must the officers be proportioned in the various grades, but, in order that they may obtain the proper experience and not be too old to perform the duties incident to each grade, the length of time they serve in each grade must be fixed. If the country is to obtain maximum efficiency for the money expended on the personnel, officers must be promoted at reasonable ages and not stagnate too long in any one grade. The present law does not consider this point at all.

Above all, the flag officer on whom the fate of battles depends should reach his grade in time to thoroughly master his duties before retirement. Six to seven years is the amount of time deemed sufficient, divided in the grades of rear-admiral, vice-admiral and admiral. As matters now stand, the ensign gets his commission at about 22 years of age. He must retire at 62. Forty years is his official life, to be divided in the grades from ensign to admiral. The reasonable ages for promotion are: Lieutenant junior grade at 25, lieutenant at 28, lieutenant commander at 36, commander at 42, captain at 47, rear-admiral at 55.

In order to provide for promotions at the above ages, some scheme of elimination of the inevitable surplus of officers is necessary, and a very simple example will show that it cannot be avoided. Take one hundred graduates who enter the service as ensigns. Statistics show that as they advance, 3 per cent annually are eliminated by casualty. With the above mentioned ages for promotion, this class of 100 would in 18 years arrive at the grade of lieutenant commander and 58 of them would be still living. As only five of this number are needed for flag officers (5 to serve 7 years, making 35 flag officers) it is evident that 53 must be eliminated between lieutenant commander and admiral by casualty or selection. To keep down the expense which this number of eliminations would cost, a graduated retired pay is necessary, and it is proposed to retire the eliminated officers after 18 years' service, at one third pay, gradually increasing the retired pay with length of service until it reaches three fourths pay after 30 years' service. This phase of the reorganization makes a new and efficient Navy cost no more than it does under the present inadequate system.

The creation of the grades of vice-admiral and admiral is a military necessity that has long been recognized, and is, of course, in line with the practice of all other navies of the world. They are not created for the personal benefit of any individual officer; the proposal would merely place the United States in its proper relation to other nations possessing fleets of war. In combined fleet operations this is a matter of great importance. In foreign services over 40 per cent of the flag officers are of higher rank than rear-admiral. The present law temporarily allows but one in the United States Navy—Admiral Dewey, who is past the sea-going age.

The feature that is of especial interest in the proposed reorganization is the amalgamation of the Pay and Construction Corps with the line. This is distinctly a progressive measure, in line with advanced thought. It is not intended to make all line officers paymasters or constructors; but it aims eventually to make all paymasters and constructors line officers. After a period of specializing, line officers will be detailed for those duties and all officers on board ship, except the surgeons and chaplains, will be combatant, i. e., line officers.

The graduates of the Naval Academy already specialize in engineering, ordnance, electricity, torpedoes, and mining. It is proposed to add naval construction and paymaster duties to their fields of activity. The gain will be enormous in flexibility, absence of corps friction, and unity of purpose. The Navy will present a solid front. It means team work of the highest order. Efficiency must, of necessity, follow. The bill proposed by the Navy Department will accomplish the above desirable results and, in addition, will safeguard the interests of the medical corps, civil engineers and marines. No change is made in the advantages now held by the warrant officers and enlisted men, who still may obtain commissions by passing the required examinations.

The hopeless condition that now confronts the Naval service in regard to promotion, is completely met by the proposed bill. Under the existing law the junior lieutenants will soon stagnate in that grade for 16 to 17 years, with no hope of reaching the commander's grade until 58 years of age. Such a condition is, of course, unthinkable, and must be promptly met.

The advantages to be secured by the above reorganization are obvious and far-reaching. It is the hope of the SCIENTIFIC AMERICAN that the friends of the Navy throughout the country will urge upon their Congressmen the necessity for the passage of the bill with the least possible delay.

It has been suggested that the measure is favored by naval officers because of personal considerations of advancement and profit. We speak from intimate knowledge when we assert that nothing could be farther from the truth. This bill is merely one expression of the earnest desire of the personnel to raise our Navy to the highest point of efficiency.

The New Haven Railroad Automatic Stop Competition

WE have received from the New York, New Haven and Hartford Railroad Company a statement of the present conditions of the competition of the $10,000 prize which they have offered for the best design of an automatic stopping device for installation on their railroad system.

When President Mellen made this offer, he scarcely realized the amount of work that the contest would entail or the strange and varied suggestions that would be submitted. To date, 1,574 applications have been received by the company, and to take care of them has entailed the services of a special force of employees. The company also obtained copies of the patent records of stopping and signal devices on file at Washington, and here they found that no less than 1,483 such appliances had already been patented.

"Applications," says Mr. Mellen, "have been sent in from all over the world. Panama, Porto Rico, Jamaica, Belgium, France, Ireland, Hawaiian Islands, England, Scotland, Wales, Germany, and Denmark are some of the countries represented in the contest. The competitors represent nearly every walk of life, from clergymen to jailbirds. Four of them are in jail, and an equal number are inmates of insane asylums. One has recently been indicted in Canada for attempting to sell stock in his stopping device company on false pretenses, and the United States post office authorities have also been investigating his stock selling scheme."

When the new devices began to come in, it was found that competitors had paid little or no attention to the instructions sent out by the company, and most of the plans had to be returned for further information. The SCIENTIFIC AMERICAN published the instructions and conditions of the contest in full in its issue of January 18th. The report before us reiterates the more important conditions of the competition: The company agrees to assist the competitor by contributions of money or use of tracks, or both, provided his device appears, in the judgment of Signal Engineer C. H. Morrison, to have sufficient merit to justify more extended consideration. The patent of the successful prize winner remains the property of the competitor, the company merely making the sole reservation of the right of use on all of its lines without further payment.

The principal mechanical and physical requirements are: first, that the apparatus must be such that the removal or failure of any essential part of it would cause the display of a stop signal and the application of the brakes. Second, it must be so designed that it may be used on the open railway, on bridges or elevated structures, in tunnels or subways, and where either steam or electricity is used as the motive power. The third and most important consideration of all is that the apparatus must not be made inoperative by snow, ice, sleet or freezing conditions. The company states that it is in the latter requirements that so many of the competitors' devices failed. Many others were thrown out by the fact that they called for overhead apparatus, which, for the New Haven Railroad, which is electrified over many miles of its system, is impracticable because of the overhead high-voltage wires which exist on its electric zone.

Of the devices submitted, only about 5 per cent were deemed worthy of consideration, and of these two only met with sufficient approval to warrant experiments at the expense of the company. The engineers of the company report that these two are worthy of installation for trial in actual operation, and they believe that through experiments and investigations one of them may be brought to a state of efficiency sufficient to meet the specifications of the prize competition.

As was to be expected, many of the devices were ingenious, but not practical. As an example of the futility of most of them, says the report, one competitor wrote that his device would not constitute a source of danger to the passenger, although its application would probably kill the engineer and fireman; but as it was to be used on the New Haven road, that wouldn't make any difference. The device of another competitor consisted of a heavy spring hook, which it was claimed would automatically rise from the roadbed when a train passed a signal, catch hold of an axle on one of the cars, thereby stopping the train.

It should be noted, in conclusion, that the problem, so far as the New Haven road is concerned, is to devise some method of conveying information from the ground to the moving locomotive, and to do this with absolute certainty in all conditions of weather.

Our Increasing Middle Age Mortality

FOR many years the public has seen in life insurance merely a means for providing against the hardships which may come to the individual owing to the uncertainty of human life; life insurance companies, looking at the matter from their own standpoint, have used mortality tables and vital statistics merely as a means of gaging the health of their *clientèle*, and hence the "risk" attached to a given policy. Even with this restricted horizon before them, the public and the companies have derived great advantages from the existing system. But the world moves forward. To-day the companies are beginning to realize that a study of mortalities can be made to render most valuable services, benefiting the public and themselves alike; for in this the interests of both run clearly parallel, that both gain by the prolongation of human life. Mr. Rittenhouse, Conservation Commissioner of the Equitable Life Assurance Society, discusses in our current SUPPLEMENT the alarming increase observed in middle age mortality in American communities. The seriousness of this phenomenon hardly needs emphasis. The middle aged man is the most valuable member of the community. What may be the cause of this increased mortality? The optimist is ready with the reply that the increase is merely apparent, or at least is the result of decreased infant mortality, whose beneficial effects more than outweigh the observed losses. For, it may be argued, if we protect our infants from the attack of the diseases, which until a few years ago made pitiless ravage among them, we shall save a comparatively few strong individuals (for most of *these* would have survived even under the old order of things), but a greater proportion of weaklings, who under the old *régime* would have been weeded out. The result will be that our adult population represents a less highly resistant stock, which therefore exhibits a higher death rate. While there may be some justification for this view, unfortunately evidence is altogether against our accepting it unqualified. In the first place the great improvement in the conditions of infant mortality is a matter of comparatively recent growth, so that its effect upon our middle-aged population can hardly, as yet, have become strongly felt. Again, comparison with English statistics shows that there the increase observed has been at most very slight, while in this country the increase in middle-age mortality within the last thirty years is estimated at no less than 20 per cent. Such increase cannot be accounted for as the mere result of the better preservation of human life in infancy, but must be ascribed, it seems, to the increased stress of modern life, and to other causes at present unknown to us.

Engineering

An Exhibition Highway.—The State of Washington will spend $8,000,000 during the next year on road construction; and in this connection it is interesting to note that an exhibition stretch of roadway is being built at Olympia, Washington, by various paving companies, each of which is laying a sample of roadway 16 feet wide and 100 feet long according to its own plans and specifications, which are filed with the State Highway Department. This stretch of roadway forms a part of the main highway north and south through the State.

Ice on the North Atlantic.—In addition to the work which will be done this spring and summer by one of our scout cruisers in patrolling the North Atlantic steamship routes and reporting the appearance of ice, the Board of Trade has announced that the "Scotia," formerly employed in the Scottish Antarctic Expedition, has been placed on the same service. The "Scotia" carries a long-range Marconi wireless plant, which will enable her to keep in touch with the stations at Newfoundland and Labrador. The cost of this scout service is shared jointly by the principal Atlantic lines and the British government.

An Automatic Stop Failure.—The report of Sir Arthur Yorke on a recent failure of an automatic stop on one of the tube railways of London makes it clear that the general principles of the automatic stop were not at fault. As compared with practice in this country, both the design and the upkeep were faulty. It was found that one of the brackets supporting the rocking shaft on which the stop arm is mounted was loose. Furthermore, the principle of control was wrong. In American practice, both the stop and the signal arm go to the danger position by gravity, should the service be broken or short-circuited. In the case of the London tube installation, the mechanism was carried to the danger position by a spring.

The Scottish Forth and Clyde Ship Canal.—When the British Admiralty established a naval dockyard at Rosyth, just above the big cantilever bridge across the Firth of Forth, it was urged that if a hostile fleet attacked and brought down the big bridge, the wreckage would obstruct the channel and shut any warships that were at the dockyard away from the North Sea. The advantage of a canal in affording two exits to the sea has given new life to the agitation for the construction of a canal from the Forth to the Clyde. The government has decided however that while such a canal would have a certain strategic value, this would not be sufficient to warrant any large expenditure by the government upon such a proposition.

The World's Largest Power Project.—The State Engineer of the State of Oregon, John H. Lewis, has submitted a project for developing 300,000 continuous electric horse-power at Big Eddy, a point three miles above the Dalles on the Columbia River. At this location the river runs through a narrow gorge which could be closed by a dam only 300 feet long, and 180 feet above its foundations, and the construction of a canal 300 feet wide, 20 feet deep and a mile and a half in length. The head of water is 73 feet at low water and 42 feet at high water and the mean flow of the river throughout the year is 235,000 cubic feet per second. The hydro-electric units would be each of 32,000 horse-power. The total cost of the scheme would be about $23,000,000.

Electric Traction on British Railroads.—The electrification of the Brighton Company's suburban railways, London, has given excellent results in the economy and the number of passengers carried. Comparing steam and electric traction, the number of trains in and out of Victoria Station in one day has risen from 496 to 739. At London Bridge the number has risen from 663 per day to 901. The number of passengers carried on the South London line since electrification has increased over four and one half millions each year over that carried during the last year of steam operation. The cost of maintenance of the overhead equipment has worked out at about $107 per mile per annum, and the other conditions of maintenance are stated to be equally satisfactory.

Engineering Activity in Argentina.—Attention is directed to the many large engineering schemes which are about to be put through in Argentina and the opportunities which are open for competition by American engineering firms. Thus the municipality of Bahia Blanca is asking for estimates for a drainage scheme to cost $1,500,000. A new water supply and sewerage scheme is to be undertaken in the capital which will cost over $20,000,000. An important electric light and power plant will probably, according to the *Engineer* of London, be the outcome of the arrangements now being concluded between the governments of Argentina and Brazil for utilizing the Iguazu waterfalls, which afford sufficient water-power to supply the two states and also the republic of Uruguay with light and fire "probably for a hundred years to come."

Electricity

Electric Power in Contracting Work.—In contracting work in which power pumps, ventilating fans, wood and metal-working tools, air compressors, hoists, concrete mixers, etc., are used, the electric motor has been advantageously employed. The flexibility and versatility of this form of power have especially commended it for the temporary applications characteristic of contracting work. A Scotch contracting concern having a piece of reservoir work on hand recently made use of electric power by installing its own gas engine and suction-gas producer generating plant. During eighteen months' operation this isolated plant—comprising a 40-kilowatt generator belted to the gas engine, supplying various motors on the work and an installation of electric lights—consumed only 55 tons of anthracite coal.

Metallo-chromes.—The electrolysis of lead salts produces peroxide of lead at the anode, and if deposited in films of varying thickness on polished plates beautiful color effects are obtained. Gassiot's process involved the electrolysis of lead acetate and an anode of a highly polished steel plate. This was laid on the bottom of a basin and covered with a cardboard perforated or cut out in some design. On this was placed a copper cathode and a current from two or three cells run for ten or twenty minutes. The film of lead peroxide on the anode or steel plate displayed the most exquisite tints of the rainbow, due to the light reflected through the film from the polished steel beneath. The tints vary in reflected and transmitted light and are best seen at a window when a sheet of white paper is inclined over the plate.

Sparkless Bell System for Mines.—Telephone apparatus is likely to be dangerous in mines where fire damp occurs, not from any sparking in the microphone, as this appears to be harmless, but from the electric bells which are needed for the telephones. While it is true that some types of electric bell are brought out which are inclosed in gas-proof boxes so that the sparks cannot cause an explosion, it appears that in practice it is a very difficult matter to keep the gas from entering. A European inventor, C. Feder, now designs an electric bell system so as to be entirely free from sparks, as he uses no moving contacts. For the current, he makes use of a special magneto, fixing the armature and rotating the permanent magnets about it, and thus the armature has no commutator or other moving contacts, but the wires come directly off the coils. No sparks can therefore occur. For the electric bell he uses a polarized armature attracted by an alternating current magnet, this working on the line current which the magneto supplies, and no sparks are given.

Wireless Telegraphy in Russian East Asia.—At the end of December, 1911, the Russian Postal Department ordered three wireless stations for the northeastern district of Asia. Each station was to consist of two steel towers 250 feet high, with antennæ and counterpoises, two kerosene motor sets of 24 horse-power each, coupled to 15-kilowatt, 500-cycle, alternate-current generators, a transmitter of 7.5 kilowatts capacity and receiving an auxiliary apparatus. The three stations are now completed and have been taken over by the Postal Department, which has opened them up to public service. They are located respectively at Ochotsk, Nayachan, and Novomariinsk. Ochotsk, situated about 1,200 miles from Vladivostok, is a small town of three hundred inhabitants on the western coast of the Ochotsk Sea. Nayachan, which is about 1,700 miles from Vladivostok, is in an entirely uninhabited tract at the north coast of the same sea, while Novomariinsk, at about 2,200 miles from Vladisvostok, is a fishing hamlet on the north coast of the Behring Sea on the mouth of the River Anadyr. Nayachan and Novomariinsk are touched twice a year by the mail steamers of the Voluntary Fleet.

Horizontal Antennæ.—Kiebitz finds that wireless waves can be received with surprisingly good results by using an antenna made up of wires stretched along at a short distance from the ground, mounting the receiving devices at the center of the antenna. For instance, upon a large flat area near Belzig he stretched several wires between pairs of posts at about 3 feet from the ground. However, a combination is made by stretching one antenna from north to south, then a second from east to west so as to cross the first one at right angles and in the middle. He also ran a third antenna across the middle point and directed NE. and SW., that is at angles of 45 degrees. This latter antenna was about 1,000 feet long and lay in the direction of the Schönberg station (40 miles off), and also in the direction of the Eiffel tower, 500 miles away, and the German post of Swinemunde (140 miles). In this way he was able to pick up these two German posts, as well as the Norddeich post, 250 miles distant. Signals could be heard very well from the Eiffel tower, and he concludes that an antenna of this length is equivalent to a vertical one of 40 feet height. Poldhu was also heard, and he could receive from Clifden and Glace Bay by using a 4,000-foot wire 3 feet from the ground.

Automobile

Paris Forbids the Muffler Cut-out.—Following the example of other foreign cities, Paris at length has seen the light, and henceforth the use of muffler cut-outs in the Fair city will bring swift retribution in the form of the law. M. Lepine, the Chief of Police, has just issued the edict making their use a misdemeanor punishable by fine or imprisonment.

A Telescopic Spoke for Spring Wheels.—In patent No. 1,050,197 Alois Zimprich of Oberndorf-Purgstall, Austria, Hungary, presents a wheel in which there is interposed between an outer rim and an inner rim, coil springs which are housed within telescopic sections which slide upon each other as the spring yields in operation.

A Spring-tire Patent.—Paul F. Wobst of Milwaukee, Wis., in patent No. 1,051,939 shows a resilient tire in which the tire casing incloses spring bows arranged within the tire casing and fastened to rods which encompass the rim, suitable brackets being employed in securing the several parts so that the casing distending spring bows will have their resilience increased.

Two Automobile-tire Designs.—Fred B. Carlisle of Malden, Mass., has secured two design patents, No. 43,453 and No. 43,454, for tires in which the first patent has formations resembling the links of a chain extending transversely across its rim and in close proximity, while the second patent has representations of linked chains extending around the circumference of its rim, the construction in both instances producing a non-skid surface.

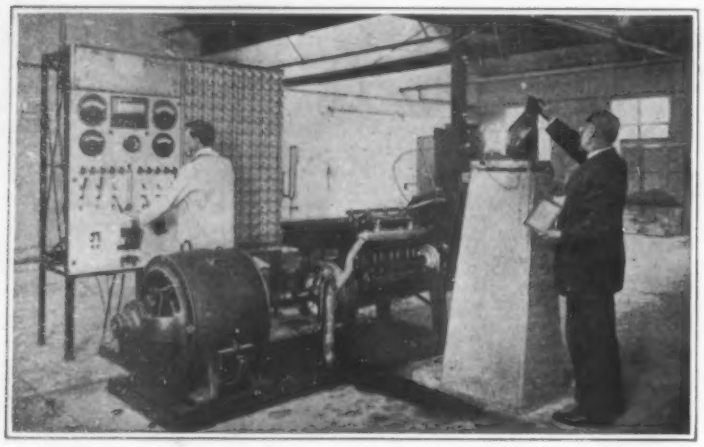
Where Germany Lags Behind.—Despite the fact that Germany is pressing ahead in the manufacture of motor cars, as evidenced by the fact that two of the largest companies recently have declared dividends of 25 and 27 per cent, respectively, she is still far behind in the number of cars per capita, judging by England and France. In England, statistics reveal that there is one motor vehicle for every 249 persons, as against one for every 441 in France and one for every 927 in Germany. This state of affairs generally is credited to the comparatively high taxation imposed on self-propelled vehicles in the Fatherland.

A Policeman's Auto Lock.—It is reported that a Washington city policeman profiting by his experience in connection with stolen automobiles, has invented a lock for automobiles for application in the ignition circuit in such manner as to form a part of such circuit. The improved device is said to comprise a rotary electrical switch with which is combined a mechanical locking device which may be adjusted so that it will not interfere with the operation of the switch and which in addition to opening the switch lock, may, by means of a suitable key, form a part of the electrical circuit and the insertion of any key other than the proper one, will not permit the operation of the lock.

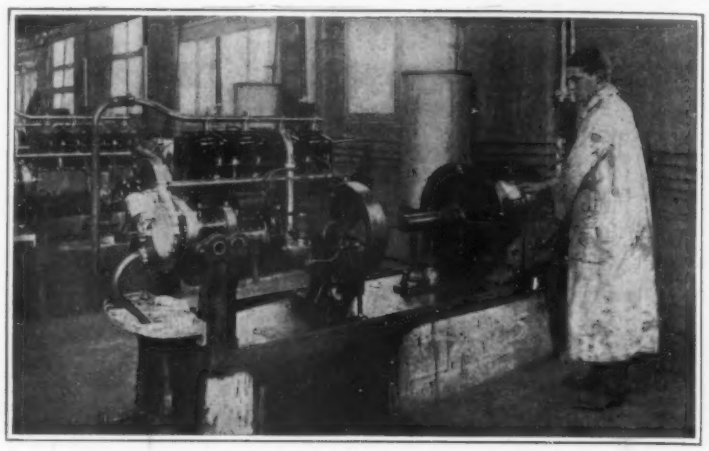
Will Kerosene be Taxed in England?—With the use of paraffin (kerosene) as a substitute for gasolene increasing, British users of heavy commerical vehicles view with alarm renewed threatenings of a tax on paraffin, which up to the present time has been free. Already, the authorities are "looking into" the matter with a view of suggesting the adoption of some such measure. The paraffin question is a difficult one, however, for even if the users of motor vehicles did not find a small tax obnoxious, it would visit a hardship on the poorer classes who depend upon oil entirely for light. Consequently, it would never do to tax it indiscriminately and there enters a neat little problem in how best to differentiate.

Phenomenal Speed of Yesteryear.—In these days of phenomenal speed and the pride that goes with it in the perfection of modern motors it is instructive occasionally to examine the records of the years gone by. As one concrete example, for instance, it is recorded (officially) that as long ago as 1908 a speed of 121.64 miles an hour was attained in England in a match race between a Fiat and a Napier. The time was made in one complete circuit of the Brooklands track and it never has been beaten to this day on the Brooklands track or on any other. The Brooklands track, be it added, is an oval approximately 2¾ miles in circumference, which makes plain that at times the speed of the winning Fiat must have been over 130 miles an hour.

The Danger of Mechanical Policemen.—An intimate study of the ultimate effects of their own devices very probably would benefit those inventors who seek to alleviate traffic conditions by bringing forth various types of "mechanical policemen" designed automatically to slacken the speed of a vehicle or to create a great rumpus immediately the legal rate of speed is exceeded. The inventors lose track of the fact that in a great many cases the salvation of the driver lies in the ability for quick acceleration. Often the time required to come to a stop to avoid collision is too short, whereas the catastrophe can be averted in nine cases out of ten by a short, quick burst of speed which, for not more than a minute, may push the hand of the speedometer well past the figure that marks the legal rate.



Testing a unit in a motor testing laboratory.



Method of testing an engine in the laboratory.

Factory Methods of Testing Automobile Motors

How the Testing Stand or Block is Used

By Stanley Petman, M.E.

FEW in these days of automobiles know of the elaborate manner in which the engines that drive the cars are tested and tried before the purchaser ever hears of them. No engine is considered perfect until it has been run for hours and hours under the watchful eye of an expert mechanic, and none is turned out of the testing rooms until it has passed the final inspector's rigid examination, has had its horse-power "pulled" and has been duly tagged and recorded.

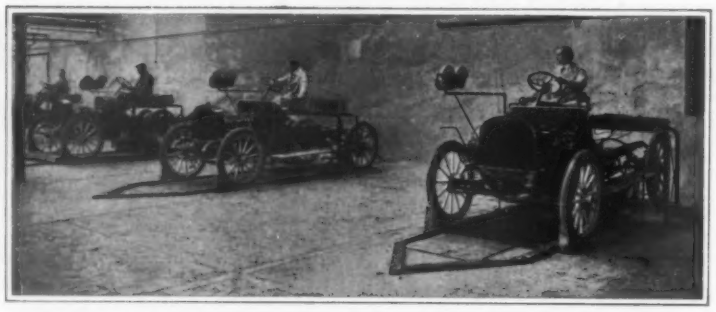
Naturally, lengthy testing of the kind is expensive, and there must be a very excellent reason for doing it. When an engine comes from the assembling rooms it is "rough." Though its mechanical features may be well-nigh perfect, the engine nevertheless is "rough;" it requires "smoothing down," and those last final touches which transform it into a perfectly running machine.

Despite the advances in the perfection of automatic machinery, jigs and templets, no two engines are exactly alike. There are bound to be slight differences of adjustment; some bearings will be smoother than others; some pistons and cylinders "fit" a little better than others. One engine obviously is the best of the lot, and it is in order to bring all the others up to that high standard, or to exceed it if possible, that careful and elaborate testing is necessary.

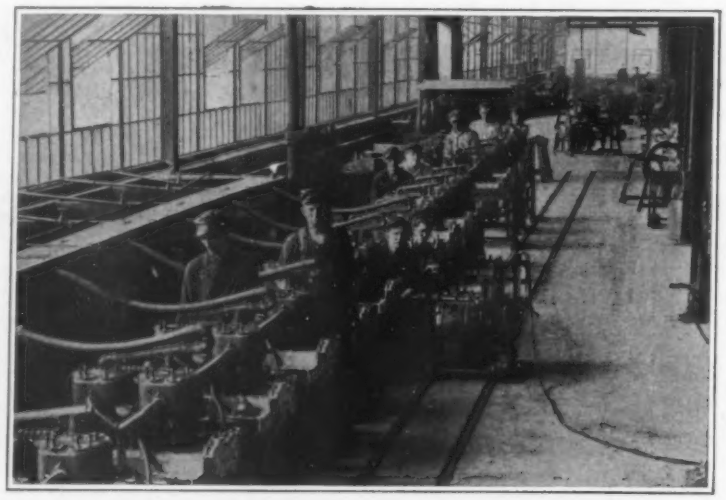
In factories where many cars are turned out every year, motors are tested on blocks arranged in rows. Generally the rows are scarcely more than a dozen feet apart; for space is always at a premium, where the reduction of overhead expense means much in the ultimate cost of the finished vehicle. The individual test blocks, too, are placed closely together, with just enough room between them for the workmen to attend to their duties.

In all such large factories, efficiency engineering principles play an important part. Ignition apparatus, for instance, and gasoline and water connections, are fastened directly to the testing block. It is necessary merely to drop the motor into place (a small electric crane is used for the purpose), and in a few seconds the "gas" and water leads and the ignition wires are attached. What are known in plumber's parlance as "quick-detachable" connections are generally used for the water and exhaust pipes.

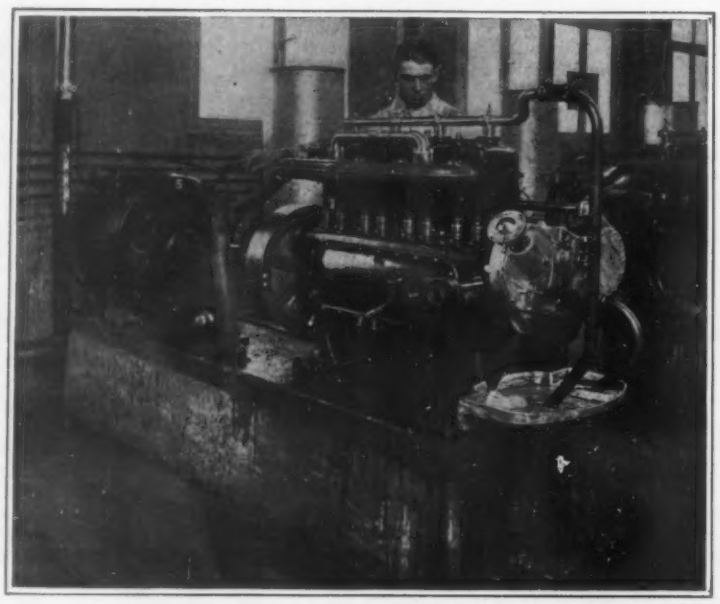
All the motors have to be "cranked," of course. In order to perform this necessary operation some factory superintendents have hit upon a novel scheme, which is the same in all cases except for slight modifications. As the motor testing blocks are placed in rows, with the motors all facing the same way, it is simple enough to lay tracks at the ends of the blocks and to mount a small car upon the tracks. On the car there may be an electric motor supplied either with suitable gearing and a short countershaft with a clutch device to grip the end of the motor crankshaft, or simply with a large pulley and a flat leather belt. Current for the electric motor is collected from overhead wires and two short trolley poles. Thus it is a simple matter to connect the electric motor with the gasoline engine in order to start it. The system has this advantage: The gasoline engine can be "turned over" for an indefinite time while carbureter or ignition adjustments are made. Inasmuch as few new motors are more easily cranked than started, it must be conceded that such a system is extremely valuable.



A new method of ascertaining power delivered at the rear wheels of a car.



Motor test blocks in a western automobile works.



One of seventeen units in a motor testing department.

Once the motors are on the blocks and running, it is the practice to permit them to run without load for periods which vary in length from four or five hours, where the factory output is large, and to 12 or 15 hours where the factory output is smaller and greater time can be devoted to the "running in" process. Sometimes motors are driven for several hours by a belt placed over their flywheels before they are placed on the blocks to be run under their own power.

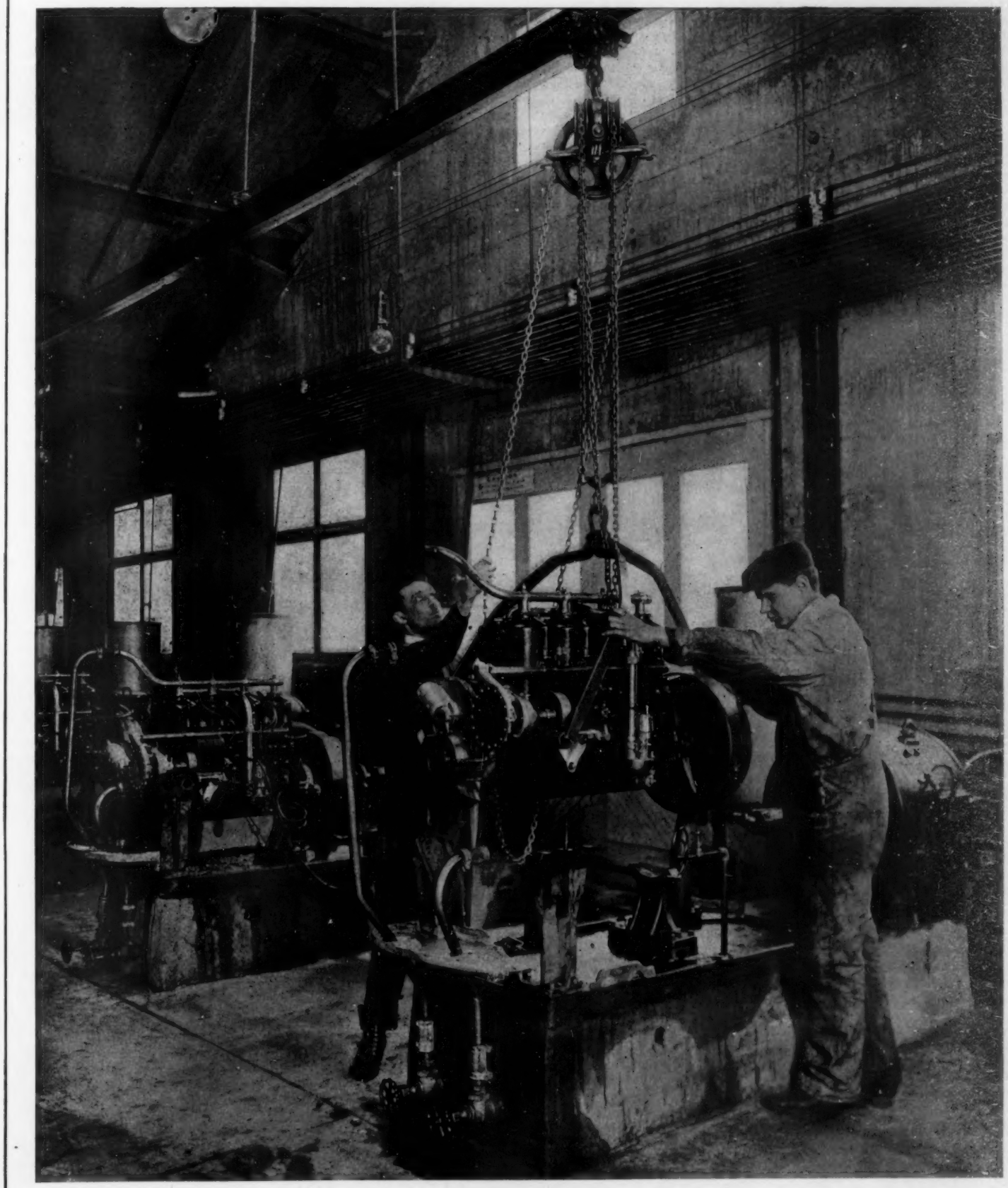
When motors are "run in" under their own power "light," they are afterward placed on other blocks and a horse-power test taken by any one of several methods. In other cases, where the output is large and the time per motor for testing is more or less limited, it is the practice to couple them directly to electric dynamometers mounted at the back of the testing blocks. In this way the motors are run in under a load, while at the same time it is a comparatively easy matter to ascertain the horse-power they are developing at any moment merely by reference to a central switchboard to which all the dynamometers are connected. When such is the case, it is easy to obtain horse-power readings with the minimum of computation. Each test block is equipped with a revolution counter, and the figuring of the horse-power resolves itself into a simple problem in arithmetic, the voltage and amperage of the generators being known and 746 watts being recognized as the equivalent of one horse-power.

If the motors are not tested for horse-power directly on the first testing blocks, but are afterward placed on other blocks in order that the horse-power readings may be taken at different speeds, either an electric dynamometer or a fan dynamometer or a water brake or a Prony brake may be used for the purpose. Computations with either the water brake or the Prony brake are slightly more complicated than those necessary with an electric dynamometer, for which reason the latter is preferred. With a fan dynamometer, however, direct readings may

be taken from a dial, which method is the simplest of all—simplest because it is known that with the fan vanes set at certain distances from the center of the carrying arms a certain amount of power will be required to drive the fan at certain speeds. Given fan speeds corresponding with given horse-powers, it is merely necessary to convert the fan speed into horse-power directly by means of a table.

For the taking of even more careful tests, there remains the indicator, an instrument which gives a graphic indication of the conditions within the cylinders during the operation of the engine. With such a device it is possible to ascertain just when the motor is operating at its best, when it could be made to operate at greater efficiency, just what the trouble is and how best to remedy any or all faults. Thus, for instance, sluggish opening or closing of the valves will be made apparent by comparing the diagram taken by the indicator with other diagrams known to be theoretically or practically correct. Similarly, incomplete combustion, which is a fault of carburetion or improper scavenging, and also incorrect timing or faulty ignition can be detected readily by means of an indicator diagram. The proper use of such apparatus, particularly on internal combustion motors, requires the greatest of care and considerable experience. Errors are so likely to creep into the results obtained, even where the operator is thoroughly qualified to make the tests, that it is rarely used except to "set" a new motor of a new type. Older motors, of course, can be set from the other, reference being made to the timing of the valves and ignition. The indicator also is very valuable in ascertaining the performance of motors which are still in the experimental stage, such as motors in which the stroke to bore ratio is greater than any that has been attempted before. Generally, indicator diagrams are taken in conjunction with the horse-power tests.

In a number of factories, testing on the blocks, supplemented by horse-power tests, is considered insufficient, and motors are given a further test after they have been placed in the chassis. There are several ways in which this may be done. Either the motor may be fastened down on its bed in the chassis and coupled up to an electric dynamometer, through the intermediary of the propeller shaft and the transmission gears, or, with the rear wheels jacked up, belts may be placed around them leading to fan dynamometers. In this way not only is the motor tested, but all of the transmission elements are tried out at the same time. A test of this kind is nearly, though not quite, equivalent to a road test.



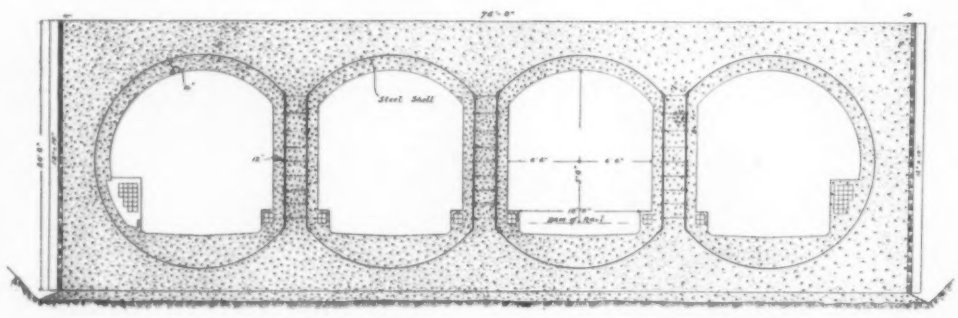
Factory methods of testing automobile motors. Setting an engine on a stand in the testing room.

Still another method is to place the completed chassis, tired, on a platform constructed for the purpose, the rear wheels resting on rollers and the front wheels

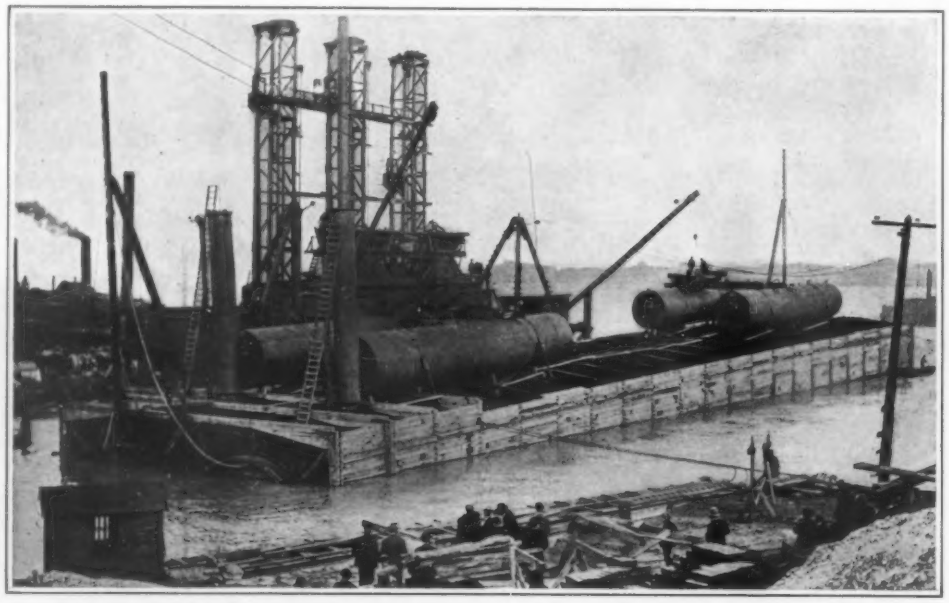
resting in chocks shaped to fit them. The rollers upon which the rear wheels rest are geared to an electric dynamometer by means of a chain. Under this method, which provides a rigorous and thorough test for the whole of the transmission mechanism as well as the motor, the operator remains seated in the driver's seat of the car with the volt and ampere meters on a standard in front of him. Consequently he is enabled to tell at a glance exactly what setting of spark and throttle levers is productive of the best results and under what condition of carbureter adjustment the motor can be induced to generate its maximum power. The readings taken, of course, represent the actual horse-power delivered at the rear wheels, and as it is this figure which counts most, after all, it may be appreciated that the test is thorough. By it, transmission inefficiencies may be ferreted out, clutch troubles detected and remedied, the cooling and ignition systems given a careful test in the chassis, and, what is even more important, the lubrication of all moving parts except the bearings in the front wheels tested. Finally, brake efficiency can be tested by the very simple expedient of operating the dynamometer as an electric motor, drawing current for the purpose from the lighting mains.

In connection with the method of employing electric dynamometers for measuring horse-power, it is interesting to note that in several factories arrangements have been made to put the current generated to some useful purpose. In one large factory in the West, where production activities are centered in the manufacture of heavy farm tractors, practically all of the current used in running the machinery of the plant is obtained from the dynamometers driven by engines on test. Preparations now are being made to enlarge the testing sheds. One of the principal reasons for the expansion is to permit the use of all current drawn from machines on test. In this way, two birds are killed with one stone, so to speak. The motors are thoroughly tested, the current used is employed in reducing the running cost of the factory, and the net result of the lowered overhead charges is reflected in the lower production cost and the lower selling price of the vehicles.

But to get back to engine testing. All such shop testing of course is merely preliminary to the road test. Regardless of what a shop test may show, no man can tell how that machine is going to operate on the road, probably in the hands of an inexperienced driver. Consequently, they are ultimately mounted in test chassis and sent out over the roads in the hands of a corps of road testers, whose instructions are to abuse them. It is their duty to seek out the weak spots either in design or in construction and to report them to the factory superintendent. Naturally, these road testers are experienced men, perfectly able to cope with very nearly every kind of trouble that may arise short of actual breakage.



Cross-section of Harlem River tunnel, Lexington Avenue subway.



Sinking a length of tunnel tubes during construction of the Detroit River tunnel.

The Lexington Avenue Subway Four-track Tunnel Under the Harlem River

THE construction of the Lexington Avenue four-track subway calls for some important sub-aqueous tunneling below the Harlem River. At this crossing it was necessary to maintain a depth of water above the roof of the tunnel of thirty feet at mean high tide, and the tunnel will be constructed to clear this level and will be built with easy grades on each approach.

The method of construction will differ radically from that followed in building the various tunnels beneath the Hudson and the East rivers, where the work was advanced by the use of compressed air and the Greathead shield. At the Harlem crossing the structure will consist of four separate steel tubes, embedded in a monolithic mass of concrete and heavily lined with concrete on the inside. When it is completed, its cross section will present the appearance shown in the accompanying drawing, and it will have a total depth of 24 feet 6 inches, and a total width of 78 feet.

The first operation will be to dredge a trench across the bed of the river, which will be 34 feet deep, that is to say, the bottom of the trench will be 34 feet below the original bed of the river, and the width of the trench will be 80 feet. The total length of the steel tubes when they are in place will be 1,080 feet. The tubes, four abreast, will be built in five sections, four of which will be 220 feet long and one, 200 feet. They will be constructed of ⅜-inch steel plates, the contiguous sides of the tubes being flattened in order to reduce the total width of the four as thus assembled. To preserve the tubes in their relative positions and keep them true to form, transverse diaphragms of ¼-inch steel will be riveted to them at every 15½ feet of their length. Along each side of the structure, these diaphragms will be bolted to vertical side walls, formed of 4-inch by 12-inch planking, backed by 10-inch by 12-inch vertical timbers, one such timber opposite each steel diaphragm. The wooden sides will be fastened to the structure by bolts which will pass through the 10-inch by 12-inch timbers and through angles riveted to the outer edges of the diaphragms.

Each four-tube section will be built on staging erected within one of the adjoining dock slips, the staging consisting of four longitudinal rows of piling finished off with longitudinal caps. When the steelwork of a section is completed, a series of scows, each measuring 14 feet by 80 feet, will be floated in between the piles, at low tide, and as the tide rises, the scows will have sufficient buoyancy to lift the tunnel sections clear of the staging. It should be mentioned that the ends of the tunnel tubes will be temporarily closed by wooden bulkheads, as shown in the illustrations. The section will then be towed out into the stream above the position in which it is to rest on the river bottom, the scows will be scuttled and withdrawn, and the structure will be left floating by its own buoyancy.

Before sinking a section, four buoyancy cylinders are strapped across the ends of the tunnel section, two at each end, and water is admitted, first to the tunnel tubes themselves and then to the buoyancy cylinders, until the latter are just awash, at the surface of the water. Two floating derricks will then take hold of the structure, one at each end, the remaining buoyancy will be further reduced, and the whole structure will be lowered away until each end rests on a grillage prepared at the bottom of the trench to receive it.

The top of the grillage platforms upon which the steel structure rests, is about two feet above the bottom of the trench; and the first operation before the buoyancy cylinders are detached is to fill in this space with concrete. The buoyancy cylinders are then completely filled with water and are released from the main structure. It is then necessary only to blow out the central compartment of these cylinders and they come to the surface by their own buoyancy.

The next operation is to fill with concrete the pockets formed by the diaphragms and the side walls. This is done by means of a big scow of the same general type as that shown on our front illustration, which represents the plan adopted in building a two-track tunnel of the same general character beneath the Detroit River. It should be stated here that the method of constructing these tunnels was devised by Olaf Hoff, C.E., who first applied his method in the successful construction of the Detroit River tunnel above referred to. The scow for use in concreting the Harlem River tunnel will be 25 feet in width by 110 feet in length. At its center will be a two-story structure containing the concrete mixers; and in front of these, erected along the side of the scow, will be five elevator towers of the type shown on our front page engraving. The towers will be so placed that each one, when the scow is in position, will stand immediately over one of the spaces between the adjacent tubes, or between the outside tubes and the side walls above described. Within each tower will be a bucket for hoisting the concrete, and on the outside of each tower will be attached a large pipe which will lead down into the particular pocket which is being concreted up.

The concrete material, broken stone, sand and cement, will be brought to the scow in lighters, loaded into hoppers above the roof of the concrete mixing house, mixed, and then loaded into the buckets in the respective towers. When the buckets are raised to the proper level, opposite the funnel-shaped tops of the concreting tubes, they will be automatically tripped and will discharge their liquid contents into the tube. The bottom of each tube will descend somewhat below the surface of the liquid concrete that has already been deposited, and the concrete will be of such fluid consistency that it will readily flow and find a fairly uniform level over the whole surface in each pocket. Means are provided for raising the tube as the level of the deposit in concrete rises, and the work goes on uninterruptedly until the whole mass has been completed flush with the top of the diaphragms.

One incidental advantage of this method of concreting is that the concrete sets under a heavy hydraulic pressure, which in the present case ranges from 22 pounds to the square inch at the bottom of the tube to 16 pounds at the top. This heavy pressure serves to thoroughly compact the concrete. We have seen a specimen of the concrete laid by this method in the Detroit River tunnel. It is a core cut from the hardened deposit and polished. It is remarkably compact, and the constituents are well distributed.

The laying and concreting of the cylinders will commence from the center and will be carried toward the ends. When the whole job is completed, the water will be pumped out from the tubes and they will be ready for their interior lining of concrete, which is 12 inches thick on the sides and 16 inches thick on the roof.

The total cost of the tunnel will be $1,620,000, and the contract time for completion, about three years from the present date. The contractors, however, are confident that it will be finished several months before that time.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Control of the Mississippi

To the Editor of the SCIENTIFIC AMERICAN:

Some features of the editorial, "The Problem of the Mississippi River," in the SCIENTIFIC AMERICAN of February 15th, should be discussed from all viewpoints, for of course the subject is so important that there cannot be too much light or sincere thought thrown upon it.

In the editorial this statement appears:

"As a matter of fact, what takes place is this; when the floods come down, the deep pools are scoured out and the material is deposited on the shoals farther down the river, causing a temporary raising of the bottom at these points. As the river falls, the action is reversed, the bars are scoured out and the sand is deposited in the next pool. Careful surveys for several decades show that not only has there been no raising of the river bed, but the cross section has slightly increased."

Please observe:

"Col. Suter considered it safe to assume that fully 400,000,000 cubic yards of material came out of the Missouri River in twelve months." (P. 47, Report by a Select Board of Engineers on Survey of the Mississippi River, Document No. 50, 61st Congress, 1st Session, H. R.)

"Other observations . . . indicate an outflow of sediment and rolling material of about 36,000,000 cubic yards per year from the Ohio River, about 5,000,000 cubic yards from the Arkansas River, and about 6,000,000 cubic yards per year from the Red River." (The same page.)

That is to say, our best authorities indicate 447,000,000 cubic yards of material projected into the lower Mississippi, taking no account of the discharge of material from such streams as the St. Francis, Yazoo, White, Hatchie, Obion, Kaskaskia, upper Mississippi, and countless minor tributaries.

The Mississippi discharges into the Gulf of Mexico a possible 300,000,000 cubic yards, which leaves 150,000,000 cubic yards at least to dispose of between the levees annually. Light sediment is washed on into the Gulf; behind it follows the vast river of gravel and sand, filling in between the levees as you may have observed, say at what is left of Island No. 10, just above New Madrid, and say at Wolf Island and Plumb Point Reach and other points, with diminishing size of particles down to the almost gritless and horrifying slime of the mud bars in the lower river. Of course, sand does find its way into the Gulf, say 30,000,000 cubic yards. (P. 79, "Levees of the Mississippi," Government Printing Office, 1867.)

Compare this 30,000,000 cubic yards of heavy material flowing out the passes with the 213,000,000 cubic yards of sand and gravel coming out of the Missouri alone (p. 47, Doc. No. 50, above referred to) and it seems clear that the position of the SCIENTIFIC AMERICAN is not according to the facts with regard to the grave question of the cross section between the levees of this day and to come. Indeed, in view of the geological history of the Mississippi bottoms, I am not a little surprised to see a position taken that is so clearly and easily demonstrated as untenable. Of course, in taking this position, the authorities consulted were mere testimony before sundry and divers committees, and not the original documents containing the figures; at least so it seems to me after carefully considering the deductions, without knowing from what data they were made. The Mississippi bottoms are largely alluvial, and the physical conditions have not changed at the behest of the hopes and desires of those who demand the maintenance of the ordinary levee projects in the Mississippi bottoms.

Of course, the question of profit is one for mathematicians to answer. If the profit of a levee system, essentially and as a matter of theory wrong, is sufficient to make up for the inevitable disasters due to topping the levees at some nearer or farther date in the future, very well; but we should not enter upon a vast expenditure blindly and with ostrich neglect of the fundamental and indisputable fact that the channel inevitably fills. Indeed, provision is already being made for this condition; the levees are being thrown up farther and farther apart, because of rising floods. I need not discuss the cause of these apparently increasing floods, nor the probable increase of the finer sediments due to wash of cut-over lands, etc. Neither is it necessary to remind the Mississippi valley students that between the levees now lies some of the most fertile of Mississippi bottom lands; while as the levees recede from the caving banks and the coiling and creeping waters they ever encroach on the better lands, crowding the cotton and other planters farther back into the swamps. That is to say, millions of acres of land between the levees is utterly wasted under the present method of levees.

The minor consideration of the narrow chute between the levees in the lower valley serves to emphasize the comparison to a spillway over a dam, the levees effectually damming the river and ponding the water in the swamps and up the tributaries and main river.

The editorial under discussion did not mean, of course, to say that 2,300,000,000 cubic feet per second is the river flow. The annual discharge varies from around 11,000,000,000,000 to 30,000,000,000,000. The per second discharge of 1903 reached 1,777,000 cubic feet. I am experiencing considerable difficulty in getting recent public documents on the subject, there being apparently no catalogue covering so important a matter as public documents relating to the river. I judge, however, that it is claimed that a second flow of 2,300,000 cubic feet has been observed. Now this is 523,000 cubic feet per second more than the previous record of 1,777,000. Before accepting these figures, it is essential that we know whether soundings were made on the date of the flow, or whether the old cross section for the point of observation was used in estimating the flow. The passing of a wave of sand at the time of the measurement would very easily account for the apparent tremendous increase in flow over the previous record. I observed in reports of the flood last spring that the coexisting stages on the Ohio and Mississippi apparently did not indicate any such increase, and I tentatively ascribed the crevasse disasters to the filling of the river bed and to the ponding of the flood by increased length of levees preventing the usual overflow at the outlets of various rivers.

I feel certain that the figure of 2,300,000 cubic feet is not accurate. Such a figure would, of course, indicate that the levee system is not to blame for the ominous failure last spring, but the figures should not be accepted without a most searching analysis of the figures from which they were made, the point at which they were made, the circumstances under which they were made, by whom, and, as heretofore remarked, whether or not the cross section or cross sections had been greatly changed, due to local or general fill and scour conditions. It is interesting to observe that the river flow varies from 97,000 to 1,777,000 cubic feet per second at Warrenton, Miss. (Tabulated Results of Discharge Observations, 1905.)

I presume that the matter of a settling pond on the Missouri has been considered in connection with the reveting of the lower Mississippi. This would stop the river of gravel and sand which menaces the lower river. In connection with reveting the river banks, on page 2,476, Report of the Chief of Engineers, U. S. Army, 1906, is as delicious a bit of humor as ever appeared in a solemn public document. Speaking of the works in Louisiana Bend, 522 miles below Cairo, on the right bank, it says:

"The total length of the original work was 15,820 feet, of which about 4,000 at the lower end has been destroyed. About half the remaining work is protected by a large sand bar!"

There is plenty of frankness and explicit detail in the reports made by the Chief of Engineers, U. S. A., and a quaint humor is occasionally discernible, especially when the men who know find themselves thwarted by those who don't.

Certainly what I have said is not an argument against the proposition to turn the whole Mississippi River project over to the army engineers now digging the Panama Canal. Give them full charge and complete freedom; only let us have a thorough understanding and a clear statement of the matter, without compelling the men who know to resort to such perfectly conscious humor as I have quoted in order to indicate the conditions under which they toil and the constant, if locally profitable, folly imposed upon the country by the piecemeal projects now under way. I need not add that I am open to conviction with regard to any Mississippi River plan or project, only the plan should coincide with figures and facts already a matter of axiomatic record.

Little Falls, N. Y. RAYMOND S. SPEARS.

The Co-operation of Capitalists and Inventors

To the Editor of the SCIENTIFIC AMERICAN:

In order to have progress we must invent, and in order to invent experimenting is necessary, and to carry on experiments capital must be available.

The greatest handicap of the young American inventor to-day is the lack of capital. It is a well-known fact that there are few real inventors who have means of promoting their inventions, for the sons of the rich never think about designing or inventing any machine to save time and labor, as their minds are employed in seeking ways to spend what they have for pleasure; however, there are exceptions to this rule. A great many persons object to the idea of taking their inventions to men of means for promotion, as many inventors have lost not only their patent rights, but much time and money that was spent in perfecting some useful machine or device by taking it to some unscrupulous party with the object of getting financial aid. There are hundreds of useful and much-needed inventions that never get on the market on account of the inventor not being financially able to place them in the channels of trade, so the patent and invention is dropped and the world never gets any benefit therefrom.

What I believe to be the most needed in the United States is co-operation between honest capitalists and competent, reliable, and progressive inventors, with thorough patent laws, in a systematic way that will protect patentees and inventors to the extent that they will have a fair showing. This would do more for the advancement of civilization and progress of our country than all the technical schools combined.

Tunnel Hill, Ga. SAMUEL H. KENNEDY.

The Neglected Study of Muscular Energy

To the Editor of the SCIENTIFIC AMERICAN:

Those of us who give much attention to the contents of newspapers and popular periodicals cannot fail to notice that as time goes on the space given over to popular presentations of scientific subjects tends steadily to increase. Not only are we made acquainted with the more easily understandable features of novel inventions and the results of original research, but in addition, general outlines of the probable future course of invention and discovery are common.

If inquiry were made, as to what special branch of science is of most vital importance to the human race, preference would probably be given to the study of the human body.

Again, if the question were put as to what generalization of modern science has influenced thought in the greatest degree, the law of conservation of energy must surely be mentioned.

Having regard to these considerations, is it not remarkable that comparatively little is to be found in print with relation to the conservation of energy and the phenomena of muscular action?

References to the expenditure of energy by the human body are abundant; the energy in question being supposed to be derived primarily from food. Consideration of the law of conservation of energy would suggest that the body may sometimes receive energy in the form of mechanical work; as when a weight is lowered gently, or a clenched hand forcibly opened. An elementary knowledge of mechanics must convince us, that muscular action may be divided into two classes, namely, the performance of mechanical work by the muscles, and the performance of mechanical work by some outside force, against the action of the muscles. A little reflection will show that the number of muscular actions falling under the latter classification is not inconsiderable, as might be supposed by some.

Whether or no the human body is able to make use of the energy expended upon it, and in what form, would appear to be of vital importance; yet in popular medical literature little reference is to be found to this consideration. Possibly the average person would dismiss this subject with a wave of the hand, remarking that the energy must be turned into heat. Personally I cannot believe that this conclusion would be well founded. F. H. ATKINSON.

London, Ontario.

The Prone Position for Aviators

To the Editor of the SCIENTIFIC AMERICAN:

A few words about the "Prone Position for Aviators." This idea was first put in use by the Wright brothers, who soon gave it up as unsatisfactory. Lying in a prone position, one cannot exert as much force upon the control levers or detect the traverse tipping of the machine as well as when sitting upright. It would be difficult to design a stream-line body that would give the aviator lying in a prone position an unobstructed view. Planing down from a high altitude the position would be very uncomfortable, as the aviator would be literally standing on his head. But why the prone position, anyway? A well-designed stream-line body can be made deep enough to permit the aviator to sit up with only his head protruding, and still not offer undue resistance to the wind.

Brookline, Mass. DAVID GREGG.

Astronomical "Bulls" Again

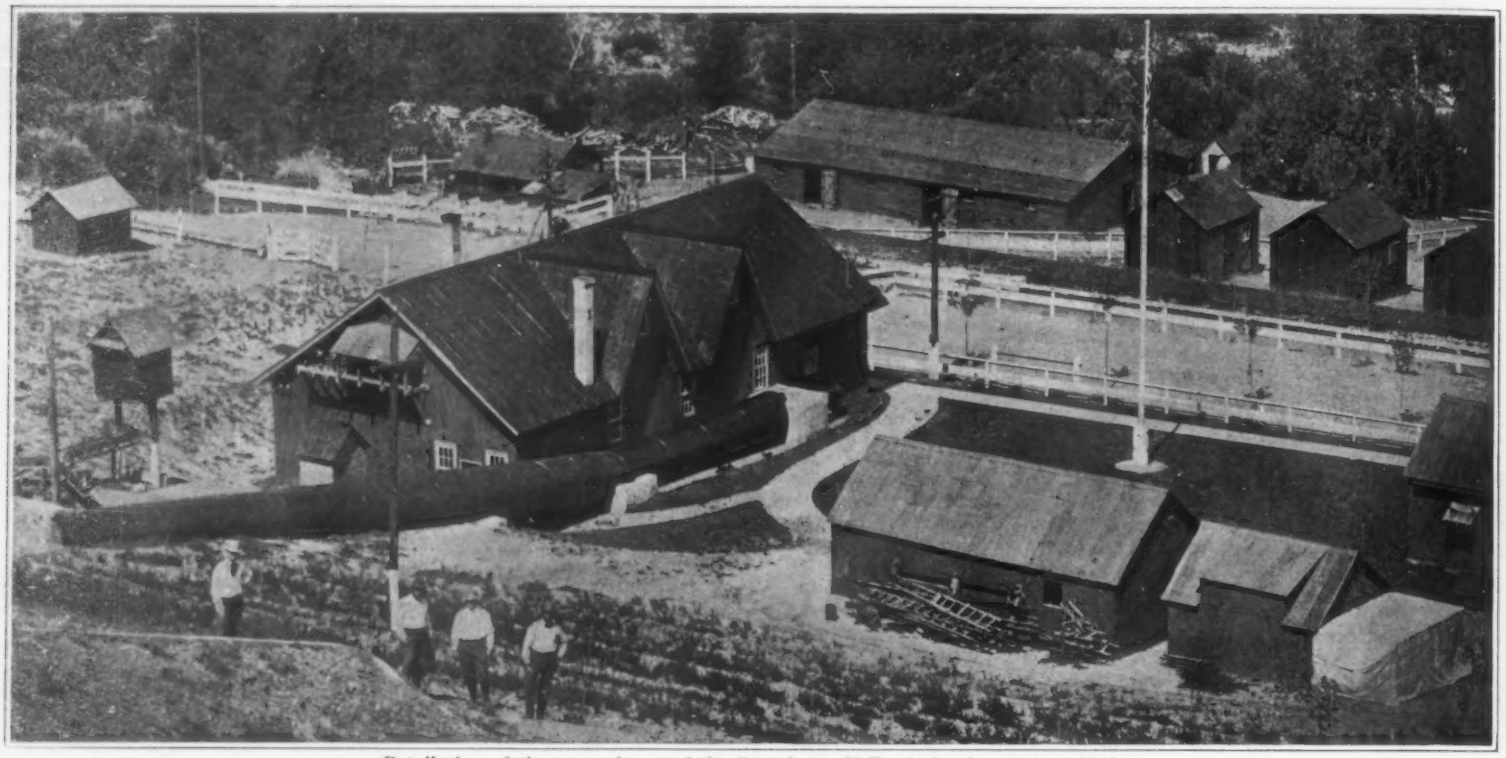
To the Editor of the SCIENTIFIC AMERICAN:

Your French Academician and his peasant recall a "bull" made by two still more famous men. In Act V, Scene I, of Coleridge's translation of Schiller's "Wallenstein" this passage occurs:

> "that single glimmering yonder
> Is from Cassiopeia, and therein
> Is Jupiter."

Coleridge has a long footnote on the passage, but finds nothing amiss in it; and if there is any reference anywhere in literature to this particular "bull," it has escaped my eye. WILLIAM HERVEY WOODS.

Baltimore, Md.



Detail view of the power house of the Strawberry Valley irrigation project, Utah.

The Great Irrigation Project at Strawberry Valley

A Remarkable Engineering Task

By Newton Forest

THE Strawberry Valley irrigation project being carried out by the United States Reclamation Service is in many respects one of the most remarkable pieces of engineering in the world. Building a four-mile tunnel through a range of mountains and picking a river from one valley and making it flow through this tunnel into another valley is an undertaking even greater than diverting the waters of the mighty river Chagres in the construction of the Panama Canal. But that is precisely what has been done.

The Mormons went into Utah Valley in the early fifties and laid out their farms along the stream that flowed down from the mountains into Utah Lake. For a time their small ditches sufficed for their agricultural needs and they prospered. As the population grew the ditches were enlarged and extended, until every available drop of water was required to meet the demands of the irrigators. In years of scanty precipitation there was shortage in the canals, crop yields were diminished and the late comers frequently lost all. Under these conditions no further development of the valley was possible, yet there were thousands of acres of land just as fertile as any in the valley, which without water were useless. Beyond the Wasatch range of mountains, which rims the valley's eastern border, Strawberry River for centuries has run uselessly by, its water flowing into the Colorado River. The rugged range of snow-capped mountains imposed a seemingly impassable barrier, and to divert the flow of the river into the thirsty valley was the gigantic problem solved by the construction of the tunnel, a huge bore nine by ten and a half feet and approaching four miles in length. This tunnel has just been completed, and when the sparkling waters rush through it down the sleeping valley a literal transformation in the physical geography of the State of Utah will have been accomplished.

With one exception this underground waterway tunnel is the largest in the world. Many hard engineering problems had to be overcome in planning it, and great physical endurance was required of the men who carried out the work. The tunnel pierces the solid rock of one of the highest peaks of the Wasatch range and diverts the water from one drainage basin to another forty-five miles away. The country where the work is being done is of a sort to add to the difficulties. For five months a year the construction camp is cut off from the rest of the world on account of the heavy snowfall. However, notwithstanding all the difficulties, a remarkable record of economical as well as rapid construction was made on the tunnel. In a single year more than 5,000 feet were driven and lined with cement. Before construction on the project could begin thousands of square miles of valley and rough mountain country were surveyed and mapped and the tunnel and canal lines marked out. A telephone line some forty miles long, extending from Spanish Fork to both portals of the tunnel, was constructed, as was also a wagon road of the same distance. Down in the foothills a diversion dam was thrown across Spanish Fork River and the waters turned into a power canal three and a half miles long, which dropped them through huge pipes on the big turbines 100 feet below. Power thus generated was transmitted electrically to the tunnel site, where it was used to turn the diamond drills, light the camps and run the heavy machinery. The camps are located a mile and a half above the level of the sea, and the work is carried on day and night in three shifts.

Looking through the four-mile tunnel which will divert a river from one valley to another.

Haying on ranch near Mapleton Bench. The alfalfa yield is four tons per acre. Three crops each season.

Beyond the tunnel, in the shadow of the granite peaks, a great reservoir is being constructed. A retaining dam 71 feet high and 490 feet in length of rock, cement and steel is being built for the impounding of the waters of Strawberry River and for the purpose of discharging them through the tunnel into canal systems leading to the arid lands of the valley. The reservoir formed by this big dam will have a capacity of 300,000 acre-feet, or sufficient to cover that many acres a foot deep.

The progress of this work has been full of dramatic and thrilling incidents. The excavation of the tunnel required the constant vigilance of the engineers and the utmost precaution to prevent disasters. Subterranean lakes and springs were opened by the dynamite blasts, and the

inrush of water frequently drove the workers precipitately from the tunnel. Cave-ins threatened injury or death, so that the concrete lining had to follow closely the drills. Notwithstanding all the difficulties confronted the Reclamation Service is completing its work in record time, and it remains now for the landowners in the valley to carry out their obligations, the first one of which will be the sub-division and sale of all individual holdings in excess of 160 acres of the lands irrigated.

The valley to be irrigated is especially interesting because it is the scene of the earliest irrigation by Anglo-Saxons in the West. Settled by Brigham Young and his followers after their march of more than a thousand miles into unknown territory peopled by savages, it is the oldest example of community farming by an English-speaking people in the great West. The attractions of this part of Utah are numerous. It is said to be one of the most beautiful valleys in the world, rivaling the best Switzerland can produce. It has a fine climate, a soil of known fertility and adapted to the growing of a large variety of profitable crops. It is the land of peaches and the big red apple, and promises to be a valley of small farms intensively cultivated, thus insuring a progressive and prosperous community where conditions will be more suburban than rural and where people will delight to dwell.

The explosion. The gases expanded in every direction, hurling fragments of the rocket many feet.

A Skyrocket Flying Machine

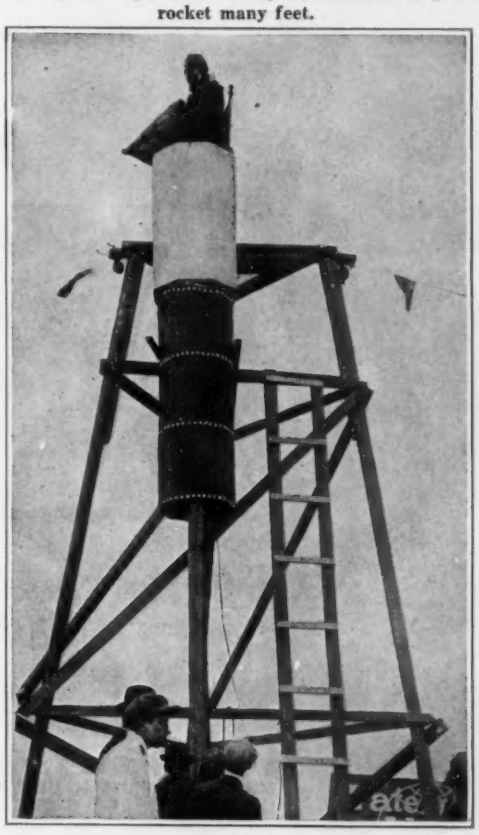
FRODMAN LAW, known for his foolishly daring feats in the air, surpassed himself in recklessness on the ominous 13th inst.

Law attempted to ascend in a giant skyrocket to a height of several thousand feet, tumble out, and descend safely by means of a new safety parachute. This parachute, the invention of A. Leo Stevens, has been used by Law many times for making perilous jumps, such as from the Bankers' Trust Building and the Williamsburg Bridge in New York city and from a biplane at a height of a mile.

The parachute mentioned is made of Japanese silk, and is carried on the back of the aviator like a knapsack. It is claimed that a 6½-pound parachute will carry a 170-pound man safely. The mere act of tumbling out of an aeroplane causes the parachute to open automatically. Law has used it many times, and always without a hitch.

The skyrocket which was to elevate the reckless Law was some 3 feet in diameter and 10 feet in length. It was carried on a heavy timber some 20 feet in length, forming the stick. A seat was provided in its upper end for Law, who sat inside the tube and was covered by the pointed top. The lower half of the skyrocket was constructed of sheet steel and was partially filled with fifty pounds of slow-burning powder—enough, it was supposed, to send the rocket with its human load 3,500 feet skyward. Unlike ordinary skyrockets, this giant structure was loaded at the head, so that it was top-heavy. It was placed beside a framing of heavy timber, as shown in one of our pictures.

After Law had taken his seat and put the cap of the rocket in position, the fuse was lighted. It sputtered for some time. Then followed a terrific explosion. The gases, instead of expanding downward as expected, burst the steel shell into many pieces. Law fell like a sack to the ground, a distance of approximately 15 feet. The parachute had no chance to open. Law was badly burned and was rushed to a hospital. He announced his intention of making another trial in the near future. Needless to say, the performance was arranged for the purpose of making a sensational moving picture, and several cameras recorded it. In this respect it was similar to Law's ascent in a balloon above the Hudson River and blowing up of the balloon with dynamite while in midair, which he accomplished without mishap several months ago.



Law in place in rocket before putting on the cap.

Wilhelm Kress, Aviation Pioneer

WITH the death of Wilhelm Kress, nearly a month ago, at Vienna, the oldest aeroplane pioneer passed away. Kress was born in St. Petersburg on July 29th, 1830. His father was a manufacturer, and the son engaged in piano building. At the age of twenty-eight Kress became interested in the problem of dynamic flight. One day while flying a kite when there was very little breeze, the exertion he was put to before the kite would soar caused the young inventor to figure out a way to make it go up of its own accord, wind or no wind. Already in 1864 he had made his first air propeller. The idea came to him to fit propellers to a kite, do away with the string entirely, and become independent of the breeze. His first model, brought out in the early '70's, was propelled by a clock spring. Not till 1877 did he make a model which flew successfully. This was propelled by elastic bands and consisted of an aeroplane surface with twin propellers and a rudder for stabilizing purposes. Three years later Kress made public flights with this model. In 1891, at the age of 56, he spent three years listening to lectures in the technical high school in order to perfect himself in mechanics. He had made numerous models which had flown, and now he wanted to produce a practical man-carrying machine. With the backing of the Emperor Franz Joseph, he was enabled to order a Daimler motor. It was supposed to weigh under 450 pounds, but when finally delivered it weighed 836 pounds. Nevertheless, Kress mounted this heavy gasoline engine in his aeroplane and tried out his machine. Unlike Maxim, Kress experimented on the water. His machine rose in the air, but capsized owing to improper balance. The inventor got a ducking, but emerged unscathed. But he was never able to explain the reason for his upset so that people would believe in him and back him still further. He had spent $25,000, most of it supplied by the Emperor. Without funds he could do nothing, and he was obliged to sit idly by and see others solve the problem of human flight when success was in his grasp.

During the last years of his life Kress was honored as a pioneer. He was an honorary member of the Aero Club of Vienna and of several technical organizations. Nevertheless, he died a poor and broken-hearted man; but not before he had witnessed the coming of the hydro-aeroplane—the machine of which he was in a sense the original inventor.

Such is the fate of many an inventor, alas! Clement Ader in France, though he survives Kress, was like him hopelessly "shelved."

The Presidency of the British Association for the meeting in Birmingham (September, 1913), made vacant by the death of Sir William White, has been filled by the appointment of Sir Oliver Lodge.

Several men were needed to carry the heavy rocket.

Carrying the rocket to be set up.

Note his aviator's helmet and the top of the rocket at his feet.

Law lying unconscious at the foot of the frame.

The Heavens in April

Do the Pleiades Shine Through a Haze of Star Dust?

By Henry Norris Russell, Ph.D.

A VERY interesting observation has recently been published in one of the Bulletins of the Lowell Observatory which relates to the nebula in the Pleiades.

It has long been known that this conspicuous star-cluster was accompanied by faint nebulosity. Only a few of the brighter parts of this are visible to the eye, but photographs of a couple of hours' exposure show that extensive areas are covered by faintly luminous filaments and streaks, which are often nearly parallel and close together over a considerable region. Longer exposures bring out extensive nebulosities extending far beyond the visible limits of the cluster.

These nebulosities are condensed about the brighter stars of the Pleiades—and some of the fainter ones—in such a way that it cannot be doubted that they are really connected with the group. But, until the recent work of Mr. Slipher at the Lowell Observatory, nothing was known of the real nature of these faint clouds of light. Their general appearance on the photographs resembles that of the Great Nebula in Orion, which is known to be gaseous, and also certain other filamentous nebulæ in the Milky Way, whose spectra contain the characteristic bright lines of the gaseous nebulæ. So it would be natural to suppose that, in the Pleiades also, the stars are accompanied by wisps of self-luminous gas.

But the actual test shows another state of things. Very long exposures are necessary to obtain properly exposed photographs of the spectra of such faint objects. But Mr. Slipher's patience was equal to the laborious task of exposing a plate in a suitable spectrograph, attached to the 24-inch telescope, for twenty-one hours, on three consecutive nights—the slit of the apparatus being so arranged that only the light from one of the brightest parts of the nebula, about three minutes of arc from the star Merope, entered the spectrograph, while the light of the bright stars of the cluster was entirely excluded.

On developing his plate Mr. Slipher found a distinct spectrum, quite different in character from that of any previously known nebula. The spectrum is in the main continuous, but is crossed by dark lines, which can be identified with certainty as those of hydrogen and helium—the hydrogen lines being much the stronger. As the discoverer puts it, this is "a true copy of the spectrum of the brighter stars in the Pleiades"—so much so, indeed, that careful tests had to be made to determine whether diffused light from the bright stars may not in some way have got into the spectroscope.

Such tests, made on Sirius, which has no nebulosity near it, showed that the diffused light was certainly not strong enough to produce any visible effect on the plate. It is therefore safe to conclude that the brighter parts of the nebulosity of the Pleiades shine with light which is exactly similar in spectroscopic character to that of the brighter stars of the cluster.

But a spectrum of this sort with dark lines on a continuous background must arise originally from a hot body surrounded by an absorbing atmosphere—in other words, from a star, or many stars.

Accepting this, there remain two hypotheses to explain the fact. One is that right behind the Pleiades, and probably very far behind, there exist great clusters of stars, just similar in spectrum to the Pleiades, but so numerous and so far off that they appear to form a continuous haze in the sky. This is exceedingly improbable; and, when it is considered that the observed nebulosity tends strongly to group itself about certain stars of the Pleiades group, the assumption that innumerable distant stars, far behind, are so arranged in the heavens that, as seen from one particular station in the universe, they seem to group themselves around these individual stars, becomes too absurd to entertain.

The other alternative is to suppose that the nebulosity in the Pleiades consists of opaque matter, perhaps of meteorites or fine dust, which accompanies the stars of the cluster, and *shines by their reflected light*. This is free from the difficulties just mentioned, and makes it very natural that the nebulosity should seem brightest near some of the brightest stars. Other bright stars are nearly clear of the nebula, which, on this hypothesis, simply means that there is little of the reflecting material near them.

A strong confirmation of this theory is found in the fact (which has long been known) that there are much fewer very faint stars in the region of the Pleiades than, on the average, in equally large regions of the sky. Such stars are undoubtedly for the most part very remote from us, and far behind the Pleiades, and it has been suggested long ago that the nebulæ associated with the group were only partially transparent, and so dimmed the light of the stars behind them, and hid all but the brighter ones. In the light of present knowledge this seems very probable.

One question remains. Can the light which the nebulæ material receives from the Pleiades be strong enough to produce an observable effect, after reflection from scattered particles of matter with wide spaces between them? The answer is in the affirmative, for Mr. Slipher shows that in the region of the nebula whose spectrum he photographed, the total amount of light received from the stars of the cluster would be fairly comparable to our moonlight—at least to that of the half-moon. Now the light even of a half moon illuminates our sky so brightly that it is quite impossible to photograph faint nebulæ like those in the Pleiades. The moonlight simply drowns them out.

The hypothesis that the nebulæ of the Pleiades shine by reflection demands therefore only that their reflecting power shall be considerably less than that of the clear air of the Earth's atmosphere. As these nebulæ are probably hundreds or thousands of millions of miles in thickness, a very small quantity of material per cubic mile would account for all the phenomena.

The writer may add that still one more confirmation of this theory can be found in the observations of more than one astronomer, which show that the brighter stars of the Pleiades are distinctly yellower than the general run of stars of similar spectral type. Now a cloud of *sufficiently fine* particles exerts more absorption on blue light passing through it than it does on red light. This is the case, for example, with light which has passed through our atmosphere, as the color of the setting sun bears ample witness. The light from the Pleiades has to pass through the nebulosity lying between us and them; and, if this is fine-grained enough, it suffices to explain the relatively yellow color of the light which reaches us.

The Heavens.

Our map shows how the skies appear to an observer who looks up at them at the hour indicated below it, for example, 11 P. M. on April 7th. At this hour the Pleiades have set (though two hours earlier they are visible low in the west). Orion, too, is almost gone; but Gemini and Auriga, with Canis Minor to the southward, still make a fine showing in the western sky. Leo and Virgo are conspicuous in the south, with the enormous length of Hydra below, and the small but conspicuous figure of Corvus on its back.

Still lower down we, in our northern latitude, may see a few stars of the Centaur, and observers south of the twenty-fifth parallel of north latitude may see the Southern Cross directly below Corvus on a line drawn through γ Centauri (which last star is just within the limits of our map).

Below β and η Centuri observers in these same latitudes may see two very bright stars, α and β Centauri. The brighter of the two—and the one farthest away from the Cross—is well known as the nearest star in the heavens.

Scorpio and Ophiuchus are rising in the southeast and east, and Cygnus and Lyra in the northeast. Hercules, Corona and Boötes occupy the eastern sky above these. Cassiopeia and Cepheus are low in the north. Ursa Minor and Draco to the right of the Pole, and Ursa Major almost overhead.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9½ o'clock: April 30.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

NIGHT SKY: APRIL AND MAY.

The Planets.

Mercury is morning star all through April, but is south of the Sun and poorly placed for observation. He is at his greatest elongation on the 24th, and rises about 4:20 A. M.

Venus is evening star at the beginning of the month, setting a little after 9 P. M. She is however rapidly approaching conjunction and becomes less and less conspicuous every night. On the 24th she is in inferior conjunction, passing apparently about 6 degrees north of the Sun, and after this time she appears as a morning star, though she will not be easily visible until next month.

Jupiter is morning star in Sagittarius. He is in quadrature with the Sun on the 6th, but being very far south, does not rise till 1:30 A. M.

Saturn is evening star in Taurus, setting about 9:30 P. M. in the middle of the month. Uranus is in Capricornus, and is in quadrature with the Sun on the 28th, but being in 19 degrees south declination, is observable only for a short time before daybreak.

Neptune is in Gemini, observable in the early evening. He is also in quadrature, on the opposite side of the Sun, on the 13th.

The Moon is new at 1 P. M. on the 6th, in her first quarter at 1 A. M. on the 14th, full at 5 P. M. on the 20th, and in her last quarter at 1 A. M. on the 28th. She is nearest us on the 18th, and farthest away on the 2nd and 30th. As she sweeps around the sky she passes Mars on the 2nd, Mercury on the 5th, Venus on the 8th, Saturn on the 10th, Neptune on the 13th, Jupiter on the 26th, and Uranus on the 27th.

On Sunday, April 6th, there is a partial eclipse of the Sun, invisible at Washington, but observable as a small partial eclipse in northern California, Oregon, Idaho, and points west and north as far as Alaska. On the coast the eclipse occurs in the morning about 10 A. M. by Pacific time.

Princeton University Observatory.

The New Port of Ceylon

A DEEP-SEA port has recently been laid out at Colombo, Ceylon, and it is to be ranked among the great ports of the world. The work started in 1895, and the area included within the protecting jetties is no less than 685 acres, which is somewhat more than for the port of Dover. A vast area had to be filled in so as to obtain ground for erecting the storehouses, quays, repair basins and coal docks. The jetties which protect the port in an almost continuous belt represent a total of 2 miles length. Good provision for the future is seen in the great size of the repair basin, this having about 700 feet length. The port has a depth corresponding to that of the Suez Canal, but it is planned to deepen it to 36 feet upon three quarters of the area. As to the cost, it is counted that the work involved an expense of $15,000,000, which is not high considering the scope of the enterprise. The present tonnage of the Colombo port is 10,000,000 tons.

"Standardizing" Highway Construction

A Plea for Rational Road Building

By Charles E. Foote

DURING the last half dozen years, in which highway building has progressed from the commonplace to the scientific stage, much has been ascertained about establishing "standards" of construction. Leading civil engineers have written books and delivered scientific addresses before learned societies with a view to the education of those whose business it is to build roads, that they may be able to follow "standards" and to construct first-class highways.

On a six-mile stretch of a New York State highway, now under construction, the specifications call for a six-inch lower course of field stone, no stone to be more than eight inches in its largest dimension, and the stone to be broken with a sledge until it will roll evenly to a firm mass with a ten-ton roller. This foundation course is placed on a thoroughly rolled subgrade. On top of the six-inch course of field stone is placed three inches of surfacing material, consisting of broken stone with a bituminous binder.

For the most part of the stretch that type of road will, or ought to, last for years; permanently, if kept properly surfaced. The subgrade is sand and gravel, and neither heaves with frost nor breaks in a thaw. The foundation course will settle into the gravelly sand and become as solid as the earth itself. And that kind of soil drains itself.

But at frequent intervals there juts out from the adjacent hills projections of different formations. One may be of hardpan; another of clay; still another of alluvial deposits; and some ledges of loose rock, probably semi-disintegrated limestone. These juttings may be anywhere from fifty to five hundred feet wide where they cross the right of way. Sometimes on account of the narrowness of the valley or the passage of the river close to the hill, it is necessary to excavate the hillside, possibly building a retaining wall to establish such a roadway as is required under the New York law, with fifteen feet of metaling and four and a half feet of shoulder and a three-foot ditch on each side.

While a New York road is taken as an illustration, because of the vast amount of construction under way at the present time, the same principle prevails in nearly every other State where road building is going on. New York has no monopoly of the idea of "standardization" in making roads.

Why does it not occur to the engineers who make the cross-sections and prepare the plans, to except from the general foundation plan those stretches which require different treatment? The veriest tyro in the road-building business should know that the standard, as applied to the sand and gravel subgrade, will not be successful when applied to other soils. There must be carefully studied systems of underdrainage, to lower the level of the bench-water to a point below the frost line; or back drainage, to prevent seepage of moisture into the road foundation; or such other treatment as the condition may require, even if the stretch of road be not more than two rods in length. Besides, under any such conditions the field stone foundation course should give place to a solid course of evenly broken stone, rolled down, sanded or filled with stone dust, flushed, and rolled some more, so as to make a foundation worthy a good road.

The one thing that may be standardized is the surface. Under present conditions of traffic the standards of to-day are likely to be obsolete to-morrow, even as the waterbound macadam road, the standard for a century or more, has virtually passed out of consideration in new construction.

A road in Madison County, Tennessee. A two-horse team has difficulty in hauling one bale (500 pounds) of cotton. Before improvement.

The same road in Madison County, Tennessee. Two horses easily draw twelve bales (6,000 pounds) of cotton. After improvement.

Excavating for a side-hill road in New York. On this subgrade will be placed a foundation of six inches of field stone, with a three-inch surface of broken stone with bituminous binder.

An Illinois road constructed with a surface of tar macadam.

About the only materials available for road surfacing under present conditions are vitrified brick, broken stone with a binder of bitumen of some sort, and Portland cement concrete. By reason of the limited deposits of clay, which will make good road brick, and the expense of freights, the use of vitrified brick is confined to limited areas. Wherever it can be used economically brick makes a most excellent road surface. It is dustless, smooth, and when properly laid, durable. It costs, according to the figures prepared by the National Paving Brick Manufacturers' Association, approximately one thousand dollars per mile per foot of width, where the expense of grading is normal and the freight not excessive. This cost includes the grade and a five-inch concrete foundation.

Different surfaces, made of broken stone and bituminous material, are as plentiful as are makers of surfacing specifications. Numerous preparations add variety to the collection. Most of them, patented and otherwise, make serviceable roads within the limits of their availability.

Concrete of Portland cement with sand and either broken stone or carefully selected gravel as a mineral aggregate, is attracting much attention. Wayne County, Michigan, has put down a large mileage of concrete roads during the past four years, and the officials express themselves as entirely pleased and satisfied with the results. Recently a plan of putting on the concrete a surfacing, or mat, of bituminous material mixed with coarse sand or fine gravel has been adopted. This method has become sufficiently recognized so that it has been adopted for a large portion of the California State highway system.

But these are merely the surfacings. The roadbed itself is the road. The surface can be repaired and replaced whenever necessary, as part of the upkeep. It can be standardized to-day, and the standards readily changed to-morrow if found necessary.

In the same absurd ratio that the soil, climate, etc., must be standardized to enable a standard foundation to be made, must the traffic be standardized to permit surfacing standards to be established. Otherwise all standards must fail.

Ten years ago there were approximately 50,000 automobiles in the United States. To-day, according to the estimates of the manufacturers, there are about one million. Then there were no motor trucks to speak of. Now trucks carrying weights of six or eight or even ten tons are not uncommon.

Ten years ago the horse-drawn traffic on our country roads was limited, practically, by what a two-horse team could pull over the worst places. A ton was considered a big load. Over the improved roads two or three tons are not uncommon. Besides, the light or pleasure-driving travel with horses has been multiplied many-fold by reason of improvement in the roads.

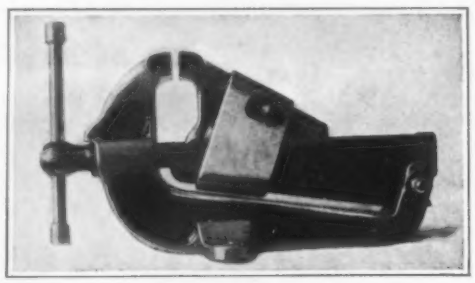
Therefore, while standards may be made for road surfaces which will meet present travel conditions, what certainty is there that the same standards will be available ten years, five years, or even one year hence? With the stresses on the roadway at least twenty-five times greater than they were ten years ago, what right have we to assume that ten years hence, either by changes and development in vehicular construction, or some new application of power, or the augmentation of traffic in some other direction, the stresses placed on the highways will not be twenty-five times greater than they are now?

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Quick-action Bench Vise

PICTURED in the accompanying engraving is a quick-action vise which differs from the ordinary in the fact that it contains no notches, teeth, or springs. Instead the locking of the jaws is effected by means of tapering surfaces. An adjustment of the jaws is accomplished instantly by simply moving a collar forward which carries the riding jaw with it. The work is first held between the jaws with one hand and the collar is moved forward until the jaws close upon the object, after which the jaws are tightened upon the work by a quarter of a turn of the screw. A quarter revolution is all that is necessary whether the jaws be open one half inch or ten inches. The screw consists of a stub threaded into the end of the bar on which the movable jaw is supported. The shoulder of the screw head extends into the overhanging lip of the stationary jaw, so that when the screw is turned in the opposite direction it will bear against this lip and force the jaws open. The thumb screw shown in the engraving on the side of the collar is simply a means to prevent the collar from changing its position until it is necessary to open or close the jaws further. The thumb screw is threaded through the side of the collar and extends into the recess in the side of the movable jaw. The supporting bar on which the movable jaw is carried is secured to the tail end of the fixed jaw, and is provided with sufficient lengthwise movement to enable the screw to tighten the jaws upon the work.



Quick-action bench vise.

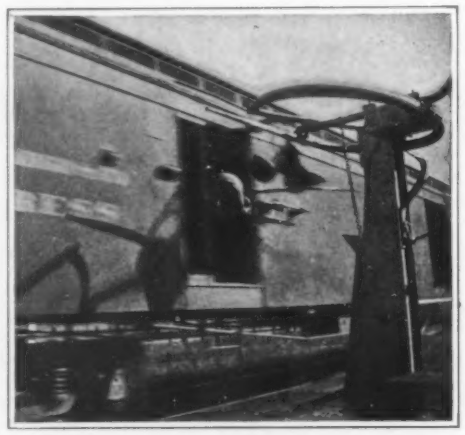
New Railway Mail Exchanging Apparatus

THE device here illustrated for the exchange of mail from moving trains was recently installed on the Coast Division, California, of the Southern Pacific Company, for twenty stations north, commencing with Burbank. The apparatus is the invention of a former postmaster at Iola, Idaho, who had his attention called years ago to the dangers of throwing out mailbags from rapidly moving trains. The problem was to absorb the shock of the blow which might reach 15 to 20 foot-tons on the arm of the standard alongside the track. This he has succeeded in doing with a horn-like receiving arm curved to a diameter of about nine feet. The operation is as follows:

On the standard erected at the depot are two curved horns overlapping each other at the point nearest to the railroad track with a delivery arm extending from the standard toward the track, below the horns. On the delivery arm of the standard is hung a ring to which a mail bag is attached. On the car is a track running along the roof, with a delivery arm on wheels. The mail clerk in the car hangs the bag by a ring upon this delivery arm. The arm is attached by a chain to a catcher hook which is placed on the outside of the forward end of the door. The action of pushing out a delivery arm along the track places the catcher hook in position and a catch or spring on the delivery arm retains the arm in position over the top of the door spring. As the train approaches the standard, the hook on the car passes through the ring, which is hung on the delivery arm at the standard, and the horn which is pointed toward the direction from which the car is coming, passes through the ring which is suspended from the car outside the door of the car. The hook on the car detaches the ring from the standard. This ring, with the bag attached, passes along the hook and is deposited on the floor inside the car. The horn detaches the ring from the arm which is suspended out of the door of the car, and the ring with the bag attached passes around the horn of the standard to the back, where it stops. This action of the horn disengages a catch above the door of the car, releasing the delivery arm which automatically returns into the car. As the bag swings around the horns, the horns themselves are turned up and remain at an angle of about forty-five degrees, thus making the required clearance along the tracks. The mailman at the depot then detaches his ring from the horn and takes away the bag.

This device was first tested at Belle Vernon, California, on the San Pedro Division of the Southern Pacific Company, some two years ago, and experiments of an exhaustive nature were made. In the experiments exchanges were made with bags that were practically empty, as well as with a number of bags at a time, weighing altogether from 150 to 250 pounds. These were delivered to the standard at speeds of from five miles an hour to between 55 and 60. At each exchange bags were taken from the standard into the car as well.

In order to demonstrate the efficiency of this mail exchanging apparatus a pasteboard crate of eggs was placed in a mailbag, together with about fifteen pounds of other mail matter. The eggs were delivered from a train moving at the rate of 50 miles an hour, and on the return journey of the train an hour or two later, the same bag was picked up again from the standard while the train was moving at 50 miles an hour. Whether any of the eggs were broken we are not informed. However, we are assured that enough came through uninjured to provide a setting for a hen which hatched out a number of chickens.



Exchanging at forty miles per hour with a 34-inch car door.

Hanging the mail bag on the crane.

Mail bag caught by the crane.

Inventors and Inventions

PUBLICATIONS of all kinds relating to improvements invariably recognize and praise the efforts of inventors. A Government bulletin issued years ago is quoted as saying, "The discoverer of new products of value in the arts and the inventor of new processes or improved machines, adds to the public wealth, and his right to the product of his brain is now recognized by the laws of all civilized nations." This is the present day view of it, but it was the aim of England in Colonial days, as said by McCulloch in his "Commercial Dictionary," "to discourage all attempts to manufacture in the colonies such articles as could be provided for them by England." Of course the purpose of this was to increase the dependence of the Colonies. Senator Platt of Connecticut, probably the best posted legislator as to inventions and patents this country has ever known, said on the floor of the Senate that the passage of the act of 1836 creating the Patent Office marked to his mind the most important epoch in the history of our development. He also said: "It is only when the brain evolves and the cunning hand fashions labor-saving machines that a nation begins to throb with new energy and life and expands with a new growth." At one time a special commissioner was sent here by a foreign nation to gather data in regard to our patent system and in response to a question as to why his people desired a patent system he, it is related, said it was asked, "What is it that makes the United States such a great nation? And we investigated and we found it was patents, and we will have patents."

Senator Platt, before referred to, also said, and this is interesting in view of propositions from some quarters to increase the Patent Office fees, "A tax upon inventors which provides more than enough to pay the current expenses of the office is simply shameful. It is a tax upon knowledge, a tax on invention, a tax which in itself is as iniquitous and abominable as a tax upon authors or scientists would be."

That distinguished Southerner, Hon. John Goode, in a public address, said that inventors "had contributed more to the welfare of their fellows in that period (referring to the last fifty years) than Alexander, Cæsar or Napoleon, and their names would survive when those of the great conquerors has passed into oblivion. . . . In future years the names of great soldiers will shine but dimly beside the names of Fulton, Morse and Henry."

The late Senator Daniel of Virginia once said, "The inventor has redeemed us from the curse of poverty, dissipated the mysteries of humbug and destroyed the monopoly of knowledge." This senator also said, "The Romans of old assigned the highest place in the Elysian fields to him who had improved human life by the invention of arts."

Guard for Overhead Trolley Wires

IN order to prevent the end of a broken, live feed-wire of an overhead trolley system from falling to the ground or from dangling in dangerous proximity to persons or animals, an inventor has devised a guard, consisting of swinging lapped fingers that constitute an emergency support for the feed wire. The fingers are suspended under the feed wire at suitable intervals, and the lapped fingers are held in position by springs so that they will move apart and permit the passage of the trolley pole.

Patent No. 1,048,066 has been granted on this device.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SUSPENDER BUCKLE.—M. KRISCHER, 146 Lewis St., New York, N. Y. The advantages of this buckle are a saving of metal, the keeping of the vertical dimension of the buckle, particularly the back thereof, within the smallest limits, and the manufacture by a minimum number of simple operations; the buckle fulfills the requirements in these respects, and by it the webbing is effectively clamped and the lower stretch formed without a double thickness of webbing at the fastened end thereof.

CREASING IRON.—H. W. POGUE, Decatur, Ill. An object here is to provide a creasing iron for clothing, made up of two juxtaposed elements, a body member provided with means whereby the side wall thereof may be heated, together with a shoe resiliently held adjacent the heated side wall, the operation being such that the material to be creased is passed between the heated wall and the shoe.

BUCKLE.—J. C. ROSENKRANZ, 116 DeVoe St., Brooklyn, N. Y. The intention in this case is to provide a one-piece buckle arranged to permit easy adjustment of the band or strap and to hold the strap securely in adjusted position without the use of tongues, teeth or similar holding or gripping devices.

Pertaining to Aviation.

AIRSHIP.—J. N. HIGHLAND, 1048 Hertel Ave., Buffalo, N. Y. Mr. Highland's invention has reference to an improvement in airships of the helicopter type, and it comprises a construction which includes preferably supporting means in the form of propeller wheels having extended blades which rotate in opposite directions.

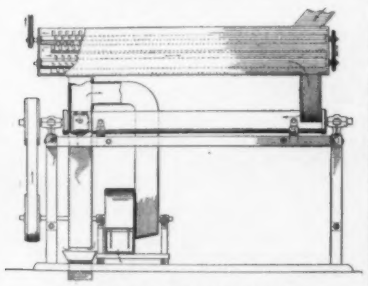
AEROPLANE.—A. J. A. DEPERDUSSIN, 19 Rue des Entrepreneurs, Paris, France. The frame consists of a latticed girder, a portion of which is removed to accommodate the motor, together with the passenger seats, the frame being reinforced underneath whereby the girder is strengthened where the lattice work has been removed, the surface thereof being rounded, thereby resembling a hull, but not to serve as a boat. This "hull," which is below the front portion of the girder, also serves as a means for attaching the suspension and landing devices; the latter are composed of rigid quadrilaterals made up of uprights secured to the "hull," together with skids having wheels attached by a flexible connection along with protecting crutches which form diagonals.

Electrical Devices.

ACCUMULATOR.—J. PIOTROWSKI and A. KILINSKI, care of L. W. Schwenk, 292 Bedford Ave., Brooklyn, N. Y. The object of the present invention is the provision of a new and improved accumulator or storage battery arranged to provide a large surface in a comparatively small space and to allow convenient escape of gases and precipitation of sediments.

Of Interest to Farmers.

DEVICE FOR TREATING GRAIN.—C. J. BARBEAU, St. Henry, Ohio. An object here is to provide a device by means of which the outer hard, flinty coat of such grain as wheat, oats, etc., may be removed preparatory to cooking the grain and canning it for use as a



DEVICE FOR TREATING GRAIN.

breakfast food. The outer hard portion may be removed without crushing the grain, so as to leave the latter in practically the same shape or form as before being treated. Means provide for causing a passage of the grain from one end of the receptacle to the other, and for retarding it in its progress, thereby insuring the complete removal of the outer coat.

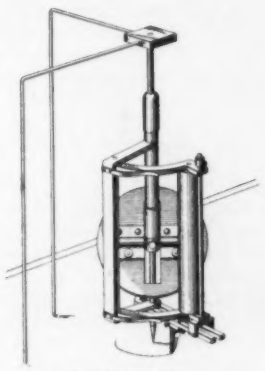
Of General Interest.

WIRE MESH FABRIC.—C. A. KULENKAMPFF, 59 Sunnyside Ave., Brooklyn, N. Y. This invention relates to improvements in wire mesh fabric, and has for an object the provision of a structure in which the horizontal and the vertical wires will be so locked together as to prevent any vertical movement of the horizontal wires.

WATER AGITATOR.—T. F. PHARO, Box 102, Tuckerton, N. J. This invention is particularly adapted to agitate the water in the manufacture of artificial ice. In the manufacture, it has been found desirable to agitate the water in order to dissolve the air bubbles therein, so as to form a clear transparent ice without air bubbles.

HAND BAG AND SIMILAR ARTICLE.—G. H. GENTZEL, care of John Mehl & Co., 128 Webster Ave., Jersey City, N. J. The object here is to provide improvements in hand bags and similar articles whereby the frame and body are fastened together by invisible means and in an exceedingly strong and durable manner, at the same time retaining the hand-sewed appearance of the bag.

ELLIPSOGRAPH.—W. S. ELLIOTT, 122 So. Cortez St., Prescott, Ariz. This invention relates to drawing instruments for describing an ellipse of any size within the capacity of the

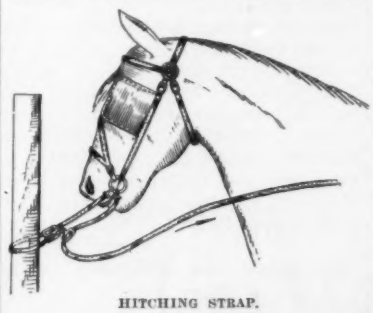


ELLIPSOGRAPH.

instrument, and it comprises in its construction various novel features permitting of a ready adjustment to vary the size of the ellipse, as desired, and to promote convenience in manipulating the members.

DRAFTSMAN'S TABLE OR STAND.—M. W. DAVIDSON, care of University of So. Dak., Vermilion, S. D. The invention comprises a cabinet upon which a drawing board is adapted to be supported, or which may be provided with a superstructure adapted to support a drawing board, the cabinet having a side opening which the board, when not in use as such, is adapted to close, together with means for locking the board in position to close the cabinet and prevent the removal of its contents unbeknown to their owner.

HITCHING STRAP.—T. SCHAFER, R. F. D. No. 5, Olney, Ill. In the present patent the invention is an improvement in hitching straps, and has for its object the provision of a simple inexpensive device of the character specified, for permanent attachment to the



HITCHING STRAP.

harness, and by means of which the draft animal may be firmly secured to a post or the like. The accompanying illustration shows a side view of the halter in place, and in a latched position.

DOOR AND WINDOW CHECK.—J. SUTER, 43 Manhattan Ave., Jersey City, N. J. The aim of the present invention is to provide a check arranged to permit of securely locking the door or window against opening from the outside by unauthorized persons, and to allow of partly opening the door or either window sash for ventilating or other purposes.

Hardware and Tools.

DEVICE FOR REMOVING STUCK DRILLS.—F. PAUL, Hastings-on-Hudson, and C. C. MITCHELL, Millbrook, N. Y., care of Chas. C. Mitchell, 414 Richmond Terrace, New Brighton, S. I., N. Y. This device is designed for removing drills stuck in a drill hole and arranged to permit of conveniently placing the device in position on the drill and surface of the rock or ground adjacent the hole to insure the exertion of the power in the direction of the length of the drill irrespective of the unevenness of the surface.

DOOR SPRING.—O. KATZENBERGER, Chicago, Ill., care of Lawson Mfg. Co., 215 W. Huron St., Chicago, Ill. The invention relates more particularly to invisible door springs, and has for an object to provide an improved structure which is of simple strong construction, and which is designed to exert such a strain on a door while it is in a closed position as to prevent wind pressure from opening the same.

Heating and Lighting.

DRY GAS CLEANER.—A. F. PLOCK, 3506 Fifth Ave., Pittsburgh, Pa. The design of this invention is the production of a dry gas cleaner tending to the more economical separation of the dust from the gas, the construction of the cleaner being such that the amount of dust per cubic foot of gas after passing through such cleaner is materially and substantially reduced.

Machines and Mechanical Devices.

CLOTH LAYING MACHINE.—J. E. JUFE, 372 Manhattan Ave., New York, N. Y. In the present patent the purpose of the invention is the provision of a new and improved cloth laying machine arranged to lay the cloth in any desired number of superimposed layers on a cutting table, and to hold the same thereon.

SAFETY DEVICE FOR THE CAGES OF LIFTS AND HOISTS.—A. G. HULING, La Salle, Ill. This automatically operating device will check the descent of a cage of an elevator or hoist in an accidental breaking of the hoisting rope or cable, and is constructed so that at the instant of the breaking of the hoisting rope or cable, the weight of the car or cage acts to throw into operation the frictional safety device.

PULVERIZED COCOA ROASTER.—P. G. HOLLSTEIN, care of J. M. Lehman Co., Carlstadt, N. J. The aim here is to slowly feed the cocoa into the roaster, while subjecting the same to a moderate degree of heat, which, however, can be increased or decreased as the nature of the article may require. The desired brown coloration of cocoa is attained by slowly passing the same through the roaster forming the subject-matter of this application.

MACHINE FOR COMPOSING AND CASTING LINES OF TYPE.—F. SCHIMMEL, 103 Rue du Sergens Blandan, Nancy, France. This invention provides an arrangement by means of which supplementary matrices each bearing several characters are automatically brought into required position in the line carrier by means of the keyboard of the machine. The compositor has only to drop the required matrix into the machine without troubling about the position it may be in, and then to strike one of the finger pieces of the keyboard, in order to automatically bring the matrix into position.

PRINTING PRESS ATTACHMENT.—R. R. MYERS, 1045 Jackson Bldg., Chicago, Ill. The object here is to form a simple, cheap and easily operated attachment, which may be attached to existing presses with but slight changes, and by means of which the forms may be tightly held and locked on the bed, without the use of the usual furniture.

BALL AND SOCKET JOINT.—R. R. HARRELL, care of Dr. D. L. Harrell, 506 Main St., Suffolk, Va. This inventor seeks to provide a novel and effective construction whereby a constant uniform pressure will be automatically secured upon the ball. He employs in connection with the ball and the seat or abutment therefor, a spring actuated cam mechanism whose action is to press the ball yieldingly to its seat.

PEDAL MECHANISM.—C. H. LADEW, SR., care of Joseph W. Birnbaum, 421 Columbia St., Union Hill, N. J. This inventor provides a mechanism arranged to permit of conveniently folding it inside of the base of the instrument and at the same time closing the pedal opening in the front of the base or to allow of swinging the mechanism outward into extended position and at the same time close the pedal opening so that the base of the casing is closed and the interior of the casing is protected against dust, whether the pedal mechanism is in folded or extended position.

MACHINE FOR TREATING TANKAGE.—C. BERTINA, care of P. Burris & Co., Ltd., Calgary, Alberta, Canada. By the usual method, tankage is pressed hydraulically to eliminate the major part of its liquid content and obtain a comparatively dry product. It is, however, slow and expensive and requires much labor that is hard, disagreeable and unhealthful. The invention devises an improved substitute consisting of a machine which effects a better result more speedily and with greater economy of labor.

VALVE.—J. J. MEYER, 366 Lenox Ave., New York, N. Y. The inventor provides a valve which is very simple and durable in construction, not liable easily to get out of order, and arranged for use as a stop cock in case it is desired to completely shut off the supply of water from the flushing tank or other similar device.

AMALGAMATOR.—S. W. MERRICK, 15 Fairchild Block, Madison, Wis. This invention has more particular relation to mining machinery employed where placer mining is practised, or where the gangue is pulverized in suitable mills and delivered to a trough, to be subjected to a water bath, for the purpose of liberating lighter materials, to be separated by gravity from the contained gold or other precious metal.

BOTTLE CAPPING MACHINE.—A. JOHNSON, 14 Dunham Place, Brooklyn, N. Y. An object here is to provide a feature for a hopper, whereby the caps to be affixed to the bottles will be fed in their proper position and in the right quantity, so that there will be no clogging, and so that there will be a cap in position at each capping operation.

Railways and Their Accessories.

CHILD'S CRIB OR BERTH ATTACHMENT FOR RAILROAD CARS.—L. W. GEEREKEY, Douglas, Ariz. The invention provides a day coach or chair-car with an adjustable and folding child's crib or berth which is supported at one side of the car in such manner that it may be conveniently brought into position in front of any one of the seats and lowered to the desired height, thereby providing an accommodation for a baby or small child.

Pertaining to Vehicles.

RESILIENT WHEEL.—F. F. TIGHE, 188 W. 102nd St., Manhattan, N. Y., N. Y. This inventor provides a wheel having a rigid rim section and a rigid hub section operatively connected by a resilient structure; and provides in a structure rigid spokes converging toward a common center and resilient guide members to maintain the said spokes in line with the center of said hub section.

RESILIENT WHEEL.—W. J. FABER, care of C. C. Faber, 1821 Brooklyn Ave., Brooklyn, N. Y. Among the objects of this invention is to construct a wheel having a pneumatic cushion spaced sufficiently far from the periphery or tread of the wheel to protect it from punctures or severe abrasion and yet provide the usual advantages of the pneumatic cushion now well known to pertain to pneumatic tires.

Designs.

DESIGN FOR A VEHICLE BODY.—W. H. DOUGLAS, Belleville, N. J., care of Healey & Co., 1652 Broadway, N. Y., N. Y. In this ornamental design for a vehicle body the design represents a side elevation in one figure and a plan view in the second figure. Both views are characterized by lines of exceedingly great simplicity and beauty.

DESIGN FOR A DOLL.—ROSE O'NEILL WILSON, care of Otis F. Wood, 303 Fifth Ave., New York, N. Y. In this ornamental design for a doll the figure of the doll is shown in two views, a front elevation, and a rear elevation. The head is large, the body round, the legs sturdy, small wings extend from the shoulders, and the arms are fully extended.

DESIGN FOR A SHOWER BATH BODY.—F. BOCKELMAN, 551 W. 174th St., New York, N. Y. This ornamental design for a shower bath body is represented in two views, one a front and the other a rear elevation. The body is cross-shaped and the lines of its form are very graceful.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

WHO'S WHO IN SCIENCE. International, 1913. Edited by H. H. Stephenson, London: J. & A. Churchill, 1912. 8vo.; 572 pp.

A book such as this, which is intended to catalogue the more scientific workers of all countries, is almost always open to criticism. Each reviewer will no doubt find that names have been omitted which in his opinion should have been included. It is of course difficult to standardize scientific attainments with such accuracy that all investigators above a certain level will surely be included, and all those below as surely excluded. Difficult, however, as the task must be of compiling a work such as this, we must commend the editor for his judgment. This year's volume is vastly superior to that of last year.

FESTLAENDER UND MEERE IM WECHSEL DER ZEITEN. Von Wilhelm Boelsche. Stuttgart: Kosmos Gesellschaft der Naturfreunde. Francke'sche Verlagsbuchhandlung, 1913.

Boelsche is one of the best-known writers of popular science in Germany. The Kosmos Gesellschaft der Naturfreunde has frequently made use of him in preparing the excellent handbooks of this series. He has a style which is not only graceful but even poetic. The subject of geology, discussed in this volume, lends itself admirably to treatment in Boelsche's characteristic way. As might be expected of him, he has given us a very fascinating account of the titanic processes that resulted in the formation of this earth.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Trucking at Railroad Terminals and Steamship Piers

THERE is no one problem in connection with the use of motor trucks in this city which is of greater importance than that of congested conditions and resultant delays at railroad terminals and steamship piers.

This is a matter which concerns both the user and the manufacturer, together with the latter's agents, and one which they should unite in solving.

That some progress has been made was shown by David Beecroft in his recent paper read before the convention of the N. A. A. M.

"Often the system," he said, "of handling freight within the depot, that is, from the time it is unloaded off the wagon or motor truck till it is loaded into the freight car, causes much delay to the motor truck. In some depots all freight is handled within the building on hand trucks, and long delays are caused when motor trucks are unloading by reason of the fact that the freight handlers have to wait for more hand trucks.

"The more enterprising railroad companies are already endeavoring to correct this abuse and have adopted an application of motion study to the method of working the men and the hand trucks. This aims at the man's having a full hand truck load, not only from the motor vehicle to the freight car, but also from the freight car back to the motor vehicle. Enormous savings of time have been accomplished in this way.

"Hand in hand with this motion study improvement is that of a new scale of payment for freight handlers based on a stated salary, and in addition a commission on all freight handled above a determined point.

"In this way the freight handler aims at working expeditiously, because he profits directly in proportion to the amount of work done.

"To demonstrate that it is possible to hasten the unloading time and also the loading time at terminal depots, one has but to look at the special facilities for handling perishable goods. Often not one quarter of the time is required for handling these goods as compared with that required when handling regular freight. The employment of system will greatly ameliorate the present difficulties.

"To show how firmly the railroad companies are convinced of this we quote from a leading Chicago freight terminal superintendent, who said: 'If motor trucks were used exclusively at six of the big terminals of Chicago, the work would be done in one half the time and at one third the cost. This would mean a saving in Chicago transportation at these six depots of $4,320,000 per year.'"

Disinterested Suggestions on Motor Truck Costs

By H. W. Perry

NOT long ago the head of a manufacturing company wrote for some disinterested information regarding the actual cost of operating and maintaining a three-ton motor truck. He admitted he was skeptical regarding the published tables of costs issued by the truck manufacturers, because he found that they figured gasoline at 12 cents a gallon and drivers' wages at $2.50 a day; whereas, he said, he could buy no gasoline at less than 16 to 18 cents, and the manufacturers of the trucks, or their agents, recommend the hiring of drivers at $3 to $3.50 a day.

Now, it had to be admitted to the inquirer at the start that wholly disinterested information on exact cost of motor trucking was very difficult to get, because the relatively few users of motor trucks who have kept complete records covering a period of several years are exceedingly reluctant to give the figures to any inquirer. They will tell you frankly that it has cost them thousands of dollars to get the information and they do not care to give it to competitors. This fact of itself is *prima facie* evidence that the motor truck is economical, because, if its users were not making or saving money by its use they would hardly have any objection to their competitors' losing money by investing heavily in such equipment.

Tables of Leading Companies.

It was necessary, therefore, to refer the inquirer to two leading companies whose motor trucks have been in the American market for the longest time, and which have published tables of average costs of motor truck operation based on data gathered from actual services extending over periods up to ten years or more. These tables show the average cost for each size of truck from one ton to ten tons capacity, and include every item of expense connected with the maintenance of motor trucks, such as interest, insurance, depreciation, etc.

To be sure these tables give the price of gasoline as 12 cents a gallon, which is low at the present time, but not too low for the average price of the fuel bought in quantity during that period. It is also true that the driver's wages are given at from $15 to $22 per week for different sizes of trucks and figured at $2.50 to $3 a day for a three-ton truck, which may be a little low for New York city, but not too low an average for the whole country. These tables show the probable cost of gasoline truck service under average normal conditions. There are several sources of similar figures for electric vehicles.

General Horse-truck Rates.

For the man who is unwilling to accept these statements because they are presented by interested agencies, there is another way of arriving at the answer. It is this:

General trucking companies in the large cities make a charge of $7 to $9 a day for hiring a two-horse team and wagon with driver. At less than $8.50 per day they are actually losing money, according to the published statement of a firm of public accountants in Boston who have shown from their investigations of many truckmen's books that it costs just $8.54 a day for a team even when it is one of an equipment of 200 head.

However, suppose we take $8.50 a day as a fair average charge for teaming. Such a team will travel fifteen miles in an average day of ten to eleven hours. A fair average load is three tons. Some truckmen claim it is five tons, but one authority, the owner of a team owners' periodical, says it is accepted as a fair average that a fair load capacity for a truck is 1½ times the weight of the team. Draft horses commonly weigh from 1,500 to 2,000 pounds, so that on this basis 6,000 pounds would be a good load. It is certain, in any case, that a three-ton motor truck will and does haul as much load as the average two-horse team. The horses stand idle a considerable part of the day during loading and unloading, and the wagon travels empty part of the time. Assume that the team is moving with full load just half of the working day The work accomplished is the hauling of three tons 7½ miles or 22½ tons one mile. The charge for this is $8.50, which makes the ton-mile cost 37¾ cents.

Motor Trucking Rates.

There are trucking companies in many cities that hire out motor trucks or do contract hauling at regular prices by the day, week or month. In New York one motor delivery company charges $13.50 a day for a 3½-ton electric truck which covers an average of 30 miles in a 10-hour day. Figured on the same basis of traveling with full load 50 per cent of the day, this gives 52½ ton miles, at an average ton mile cost of 25¾ cents.

Another company hires a gasoline three-ton truck for $20 a day and says the machine will average fifty miles a day. The work done is seventy-five ton miles, on the 50 per cent working basis, and at $20 a day this makes the ton mile cost 26 2/3 cents.

In both cases the cost is only about two thirds that of doing the work with horses. These are actual prices and actual mileages as given by companies that make their living at the business. It is not in the least likely that the motor truck man makes a smaller percentage of profit than the teamster—on the contrary, it will be generally conceded that he makes considerably more. Therefore, it needs no further argument to prove that, under suitable conditions, it costs less to do hauling by motor truck than with horses.

Even at a cost of $20 a day, the power vehicle is cheaper than horses, but the truck manufacturers' cost tables previously mentioned show that the average cost of running a 3-ton gasoline truck is approximately $12.25 a day instead of $20. Granting that this is a fact, it brings the ton mile cost down to 16 1/3 cents, or less than half the cost of horse haulage. How much is this result going to be disturbed if we add half a dollar a day to the driver's wage and four or six cents a gallon to the cost of gasoline? As a matter of fact, fuel is one of the least items in motor truck costs.

Only the saving in trucking costs has been touched upon, but economy is, after all, not the greatest virtue of the power vehicle. Its speed and endurance make it a great business builder. The ability to make very quick deliveries, often at great distances, regardless of weather conditions and railroad delays, wins and keeps many customers that could not be served at all by a merchant or manufacturer dependent upon teams.

Increasing the Efficiency of a Stage Line

THE possibilities of increasing the efficiency operation of a fleet of motor vehicles are well illustrated in the case of the Fifth Avenue Coach Company of this city, as shown by the last official annual report on file at the Public Service Commission. This report covers the year ending June 30th last, and discloses a policy of retrenchment and economy, which greatly reduced operating expenses without apparently affecting the service rendered to the general public.

One of the principal savings came in reducing the number of "idle" miles covered by the motor 'buses in traveling between the garage and their starting points, from 23,000 miles to 5,951 miles. This was accomplished by erecting several garages and stations, so that the 'buses could be kept very near their starting points. Another was in reducing the cost of tires from $67,563.96 to $45,124.51, despite a greater mileage; the cost of tires per 'bus amounting to 3.13 cents, against 4.98 cents for the preceding year.

One of the principal reasons assigned by President Meade for the marked reduction in tire cost was the purchase of tires outright istead of buying tire mileage. Herein is something for users of commercial motor vehicles to ponder over, and especially its application to the vehicles itself. The prevailing tendency to buy motor truck service guarantees instead of buying the motor trucks themselves on the same basis that most manufactured products are sold, does not work out well for either party concerned.

Motor Truck Researches at the Massachusetts Institute of Technology

To the Editor of the SCIENTIFIC AMERICAN:

The letter of the Harrolds Motor Car Company commenting on some results abstracted by me from the second report of progress of the Massachusetts Institute of Technology vehicle research furnishes, it seems to me, the best kind of evidence of the need of just such impartial investigation as that which Technology is carrying on, which has no purpose save the determination of the precise truth.

Two comparative tables are prepared by the Harrolds writer, one of a Pierce-Arrow truck, giving operating costs, and the other selected from the Technology figures for electrics. Unfortunately the tables do not follow the same form, and it is not easy to determine whether they cover properly the same items. For example, there appears in the Technology table a "sundries," $260, with apparently no corresponding figure in the P-A table.

One fault in the attempted comparison is that while the factors for the Technology trucks are all determined and of record, the P-A figures have no stated sponsors or pedigree. One is in doubt whether they are stereotyped trade estimates or have really been deduced from observing the costs of a truck—or trucks—but nothing is said concerning the age, condition, nature of work, kind of roads or other modifying and important items.

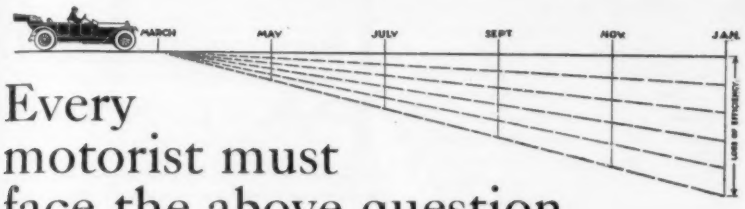
The prime difficulty, however, is with the Harrolds figures of tire cost and repairs. Technology has had under observation many gasoline trucks, the figures for which are published. They will serve in their average for a sort of standard by which the Harrolds figures may be judged. Now the costs of tire are claimed for the P-A five-ton truck at $0.0611 per mile, while the average of seventeen assorted five-ton gasoline trucks watched for a year at least by Technology is $0.0885. Similarly for repairs, the Harrolds figure is $0.025 per mile, but the cash that the owners of the seventeen gasoline trucks actually paid out for repairs last year proves to be $0.0865.

Such differences in the fundamentals obviously put any comparison of the figures out of the question until they can be reduced to some mutual standard, and the situation is further complicated by the apparent claim that the life of a P-A five-ton motor truck is twenty years.

The final paragraph in the letter, however, can hardly be left unchallenged when one becomes aware of the full facts in the Technology investigation. In view of these the expression, "The electric vehicle makers seem willing to let the matter stand as it is while we are doing our best to get the true figures so more accurate comparisons can be made," seems a little unfortunate. The "we" is presumably the Harrolds Company or possibly the gasoline car makers in general. But the fact is that the first large research for the truth undertaken with adequate means and under the conditions of actual daily work is that which Technology has now under way. The initiative and the greater portion of the funds for its prosecution have come thus far from electrical interests. There has been money from gasoline car makers for special matters, which is gratefully acknowledged, and other funds have been given like that of Edison for special battery research, but the bulk of the support has been furnished by the Edison Electric Illuminating Company of Boston. This organization is seeking the precise facts and has financed the investigation without any assurance of what the results will show. Other endowment by other interests will of course afford results more quickly than is now possible, while the reputation of the Institute guarantees accuracy and impartiality.

JOHN RITCHIE, JR.

What will the year 1913 do to your car?



Every motorist must face the above question.

At the end of the season the value of your car will depend almost wholly upon the condition of your motor.

That will depend mainly on the lubricating oil you have used.

Motor-wear is not accidental. It results from friction.

Excessive friction is bound to follow the use of an oil whose "body" is unsuited to your feed system, or whose lubricating qualities cannot properly withstand the demands of service.

Common results are:

(1) Undue loss of power.
(2) Unnecessary repair troubles.
(3) An excess consumption of fuel.
(4) An excess consumption of lubricating oil.

To avoid these losses, your motor must be supplied with:

(1) An oil that will retain efficient lubricating qualities *under the heat of service.*

(2) An oil that will *wear well* in use.

(3) Oil of a "body" that *will properly feed to the various friction points.*

Motors differ.

No short-cut method can determine the oil that best meets your feed requirements.

The construction of your motor *must* be analyzed and carefully considered.

The piston clearance must be known; the fit of the piston-rings into their recesses; the length of the crank shaft and connecting-rod bearing; the feed-system; the length of the vacuum period while intake and exhaust valves are both closed.

We have undertaken this serious problem with the thoroughness that has established our standing in the general lubricating field.

To arrive at correct automobile lubrication we have done what *must* be done. Every year we carefully analyze the motor of each make of automobile.

Based on this motor-analysis, and on practical experience, we specify in a lubricating chart (printed in part on this page) the grade of Gargoyle Mobiloil best suited to your motor.

The superior efficiency of the oils specified has been thoroughly proven by practical tests. In sheer lubricating quality, we can safely say that they stand alone.

So far as correct lubrication can assure it, the grade of Gargoyle Mobiloil specified for your car assures:

(1) The greatest horsepower efficiency.
(2) The smoothest operation.
(3) The fewest repair troubles.
(4) The lowest operating cost per mile.
(5) The longest life to your motor.
(6) The greatest second-hand value.

Throughout the world you will find that the authoritative leadership of the Vacuum Oil Company in matters of lubrication is unquestioned.

The lubricating chart on this page represents our professional advice.

If you use an oil of less correct "body" or of lower lubricating efficiency than that specified, your motor faces unnecessary friction and ultimate serious damage.

In buying Gargoyle Mobiloil from dealers it is safest to purchase a full barrel, half-barrel, or a sealed five-gallon or one-gallon can.

See that the proper name and the red Gargoyle, which is our mark of manufacture, appear on the container.

A booklet, containing our complete lubricating chart and points on lubrication, will be mailed to you on request.

The various grades of Gargoyle Mobiloil, refined and filtered to remove free carbon are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "D"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

They can be secured from all reliable garages, auto-supply stores and others who supply lubricants.

VACUUM OIL CO.
Rochester, U. S. A.

BRANCHES

NEW YORK 29 Broadway
DETROIT Ford Bldg.
BOSTON 49 Federal St.
CHICAGO Fisher Bldg.
PHILADELPHIA 4th & Chestnut Sts.
INDIANAPOLIS Indiana Pythian Bldg.

Distributing warehouses in the principal cities of the world

A guide to correct Automobile lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A" means "Gargoyle Mobiloil A." "Arc." means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil A. The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	...	...	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Apperson	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	E	A	Arc.	A	Arc.	...	...
Avery	...	...	A	E	A	E	A	A	A	A
Benz	A	A	A	A	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A	A	A
" (4 cyl.)	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (1 cyl.)	B	A	...	...	...	...	...	...	...	...
" (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	A	A	E	A	E	A	E	A	E
" Com'l.	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
Case	...	...	...	...	A	A	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Chase	B	B	B	B	B	B	B	B	B	B
Cole	...	...	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Columbia	A	E	E	E	A	A	A	A	...	...
" "Knight"	...	...	...	...	...	...	A	A	A	A
Couple Gear	A	A	A	A	A	A	A	Arc.	A	Arc.
Daimler	A	E	A	E	A	E	A	A	A	A
" "Knight"	...	...	...	...	A	A	A	A	A	A
Darracq	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
De Dion	B	A	B	E	B	A	B	A	B	A
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
Elmore	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
Fiat	B	A	A	A	B	A	A	A	B	A
Flanders	...	...	E	E	E	E	Arc.	Arc.	...	...
" (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
Ford	E	E	A	Arc.	E	E	E	E	E	E
Franklin	B	E	B	Arc.	A	Arc.	A	Arc.	A	Arc.
" Com'l.	B	A	B	A	B	A	A	Arc.	A	Arc.
G. M. C.	...	...	...	...	...	...	Arc.	Arc.	A	Arc.
Gramm	...	...	...	...	A	Arc.	A	Arc.	A	Arc.
Gramm-Logan	A	Arc.	A	Arc.	...	...	...	...	...	...
Herreshoff	A	A	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Hewitt (2 cyl.)	A	A	A	A	A	Arc.	...	...	...	...
" (4 cyl.)	A	E	A	E	A	Arc.	E	E	E	E
Hudson	...	...	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" "32"	...	...	...	...	...	...	...	...	A	Arc.
I. H. C. (air)	...	...	...	...	...	...	...	...	B	A
" (water)	...	...	...	...	...	...	...	...	A	A
International	B	A	B	A	B	B	B	A	...	...

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Interstate	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Isotta	A	A	A	A	A	A	A	A	A	A
Itala	A	A	A	A	A	A	A	A	A	A
Jackson (2 cyl.)	A	A	A	A	...	...	...	...	...	...
" (4 cyl.)	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Kelly	...	...	...	...	Arc.	Arc.	Arc.	Arc.	...	...
Kelly Springfield	...	...	...	...	...	...	...	...	Arc.	Arc.
Kissel-Kar	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
" " Com'l.	...	...	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kline Kar	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	...	...	A	A	A	A	A	A	A	A
Lancia	B	A	B	A	B	Arc.	B	Arc.	B	Arc.
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Mack	A	E	A	E	A	E	E	E	E	E
Marion	A	E	A	E	A	E	A	Arc.	A	Arc.
Marmon	Arc.	Arc.	A	E	A	Arc.	A	Arc.	A	Arc.
Matheson	Arc.	Arc.	Arc.	Arc.	A	A	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	E	E	...	...
" (4 cyl.)	E	E	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
Mercedes	A	E	A	E	A	E	A	E	A	E
" "Knight"	...	...	...	...	A	A	A	A	A	A

Mobiloil

A grade for each type of motor

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Mercer	...	...	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Michigan	...	...	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Minerva "Knight"	...	...	...	...	A	A	A	A	A	A
Mitchell	A	A	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Moon	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
National	A	Arc.	A	A	A	A	A	A	A	A
Oakland	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Oldsmobile	A	E	A	E	A	Arc.	A	Arc.	Arc.	Arc.
Overland	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Paige Detroit	...	...	E	E	A	Arc.	A	E	A	E
Panhard	A	E	A	E	A	E	A	Arc.	A	Arc.
" "Knight"	...	...	...	...	A	A	A	A	A	A
Pathfinder	...	...	...	...	...	...	...	...	A	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" " Com'l.	...	...	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Pullman	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Rambler	A	A	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.
Rapid	A	A	A	A	A	Arc.	Arc.	Arc.	...	...
Rayfield	...	...	...	...	...	...	A	A	A	A
Regal	A	E	A	E	A	Arc.	A	E	A	E
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
S. G. V.	...	...	...	...	B	Arc.	B	Arc.	B	Arc.
Selden	A	E	A	E	A	B	Arc.	Arc.	Arc.	Arc.
Service	...	...	...	...	A	A	A	Arc.	A	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" "Mead"	...	...	...	...	...	...	...	...	A	Arc.
Stanley	D	D	D	D	D	D	D	D	D	D
Stearns	A	A	Arc.	Arc.	A	Arc.	A	Arc.	...	...
" "Knight"	...	...	...	...	...	...	A	A	A	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	E	E	Arc.	Arc.	A	A	A	A	A	A
" " "Knight"	...	...	...	...	...	...	A	A	A	A
Studebaker	A	E	E	E	A	Arc.	Arc.	Arc.	A	Arc.
Sturtz	...	...	...	...	...	Arc.	Arc.	Arc.	Arc.	Arc.
Thomas	E	E	E	E	E	E	A	E	...	...
Walter	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Warren Detroit	...	...	Arc.	Arc.	A	A	A	A	A	Arc.
White (Gas)	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (Steam)	D	D	D	D	D	D	D	D	D	D
Winton	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

A Diesel Locomotive

FOLLOWING closely the successful application of the Diesel and the semi-Diesel-cycle types of heavy oil-burning internal combustion motors to the propulsion of ships, a Diesel-engined locomotive of German origin recently passed through a series of highly satisfactory tests operating under ordinary traffic conditions on a Swiss railway. The power plant is a four-cylinder, two-cycle engine capable of developing a maximum of 1,200 horsepower.

The engine is of the "V" type with cylinders set at an angle of 90 degrees, and the crank-shaft is connected directly with the four driving wheels, without the interposition of clutch or reduction gears, by means of side coupling-rods. Naturally this construction implies a great torque for starting and for heavy hauling at low speeds. Hence provision is made for "forcing the combustion," that is for continuing the injection of both fuel and air through a greater portion of the stroke than is done under ordinary circumstances when the engine is operating at its normal speed. This forced combustion has the same effect on the Diesel engine as the elimination of the cut-off on the steam engine. The initial pressure is maintained for a longer interval, and naturally the gases are not expanded to the extent that obtains under normal operation. As with the steam engine, the efficiency—fuel economy—is greatly reduced, but the available power is greatly increased, which is the object sought.

By way of supplying the demand for extra air when the engine is operating under forced combustion, a separately driven horizontal compressor is mounted forward of the power plant, and is driven by means of an auxiliary two-cylinder Diesel motor. The compressed air is stored in suitable steel tanks, ten in number, provided at the rear of the cab. Between the cylinders of the main engine are the scavenging pumps and the exhaust manifolds, which lead to a muffler placed on the roof. Both engines are cooled by means of pump-circulated water, maintained at the proper temperature by means of a radiator situated on the roof to the rear of the engine. The air, water and fuel pumps are all driven directly from the crank-shaft as in ordinary Diesel practice. At the rear of the car is a small steam boiler, oil fired, which supplies the steam for heating the coaches in cold weather.

The locomotive, which is 54 feet 3 inches in length over the buffers, is provided with two four-wheel pony trucks disposed at either end, with the four large drive wheels in the center. It weighs, with the tanks full and ready to run, about 85 tons. It is fully inclosed and has the appearance of a steel car. Air is admitted for the compressors through channels just under the roof. Inside the car are platforms on either side of the machinery.

Just what the effect of forcing the combustion will have on the durability of the engine is a matter that will not be fully determined for some time to come. It would seem, however, that the continuation of the combustion for a greater or less portion of the stroke, according to operating conditions, would subject a great portion of the cylinder walls to the action of the very intense heat that prevails while combustion is in progress, which circumstance would militate against perfect lubrication and cause the engine to assume a temperature that is neither conducive to perfect operation nor to longevity.

Preventing the Key from Turning.—John Keys of Kansas City, Kan., in a patent, No. 1,049,493, shows a locking device wherein a fastener is attached to the frame of the door and has spring lips flaring to form a mouth and a keeper socket back of the mouth and a key is made in sections pivotally connected so that the ward portion of the key may be inserted in the lock and the handle portion may be swung between the spring lips into the socket, thus locking the key.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12762) D. G. S. asks: Will you please give information in regard to the weight of the earth or globe? Is it or is it not heavier now than when first completed? A. The earth is heavier now than it was at the first by the weight of the meteors which strike it from time to time. Some of these are very small, and others weigh considerable. The one brought from Greenland by Admiral Peary weighs some forty tons. It is now in the American Museum in New York city. The earth, however, is so heavy that these additions to it do not affect it to any appreciable degree. 2. The ocean is the reservoir of all the rivers and small streams, and it is salt water. In returning back to the heads of all the streams, why does it not bring the salty taste with it? A. The salt of the ocean is not evaporated, but remains in the ocean water. The water which evaporates and goes back in clouds to be dropped as rain on the mountains is fresh water only. You can prove this to yourself by dissolving some salt in water and letting it stand in the open air. As the water evaporates, the water tastes stronger of salt, until it can hold no more salt. Then crystals of salt appear in the dish. Finally, when the water has all disappeared, you will find all the salt in crystals on the dish.

(12763) I. J. P. asks: In a lecture on "The Great Pyramid of Egypt" it was stated that it was built true to the meridian in its day. May I ask your Notes and Queries: 1. If a shift in earth's axis, what direction, rate and cause? A. The change of the earth's axis which the lecturer spoke of, does not refer to a change of the axis in the earth itself, which would change the latitude of places, but to a change of the direction of the axis in space, which causes a motion of the axis of the earth like that of a spinning top. This motion is called the precession of the equinoxes, and is explained in all astronomies. See Young's "Manual of Astronomy," price $2.50 postpaid. 2. How much does the pyramid vary from the present meridian, and the time this variation would require? A. At the time of the building of the Great Pyramid the brightest star in Draco was the North Pole Star, and the entrance passage of that pyramid was directed toward that star. It is now many degrees from it. It will require 26,000 years for one revolution of the pole of the equator around the pole of the ecliptic. Then the same star will be the pole star again. 3 Are the lines, proportions, facing of stones in the Great Pyramid more accurate than modern engineering works? A. We do not suppose that any more mechanical skill was possessed by the builders of the pyramids than engineers possess nowadays. They did their work well. The pyramid is well placed north and south, east and west. There are those who believe that the pyramid can teach us all measures and weights, the size of the bushel and other measures, the length of the year, the precession of the equinoxes, and much besides. See Piazzi Smyth's great work in two volumes on "Our Inheritance in the Great Pyramid."

(12764) F. A. S. writes: In your issue of February 1st, P. S. F. mentioned the presence of many angle worms on a crust of snow. Now, in your January issue (page 17) there is a short notice of M. Thaulet's explanation of how large pebbles are carried by winds. Might we not adopt his theory to the case in hand? Might we not say, with him, that we must accept the idea of fixation around the worms, frogs, toads, and snakes (I have witnessed the presence after a heavy rain of at least four little snakes in Chicago's house-yards, whose being there at all could be explained only by the supposition that they were carried there by the rain and wind) of an envelope of air or water vapor? The density of the transported mass of combined solid and fluid matter would then be that of the worm, etc., and would be sensibly lighter with respect to its volume. This spheroid would be borne by the wind much like a stiff card sailing through the air. A. We have no theory to defend as to the manner in which these particular worms came to be where they were found. Probably they came from the earth underneath. But it is possible in some of the cases of small animals appearing after a severe whirling storm has passed over, that they have been taken up by the whirling air and carried long distances. The reference you make to the SCIENTIFIC AMERICAN of January 4th, 1913, page 17, is in point. Waldo, "Elementary Meteorology," page 248, gives the velocities which will take up articles of various weights. Some of these are heavier than angle worms, and the wind velocities are lower than are frequently encountered. It is clearly possible that such instances as you cite may be due to ascending whirls of air, or to storms whose axis is nearly horizontal. Such a storm could empty a puddle of water, tadpoles, etc., and sweep them off to drop them many miles from their former home. It is possible, but not so unlikely, that this cause should only be invoked when the related facts justify it. One correspondent has taken us severely to task in this matter, but we are not ready to yield the possibility of these occurrences in some instances.

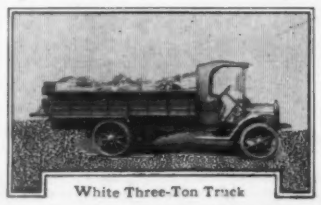
The White Factory at Cleveland, Ohio
Where White Motor Cars and Trucks are Manufactured

White *Self-Starting* Six-Sixty Touring Car

White *Self-Starting* Six Berline Limousine

White Five-Ton Truck

White *Self-Starting* Six-Sixty Roadster



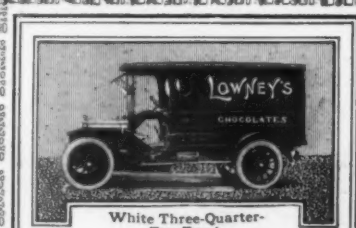
White Three-Ton Truck

The greatest variety of motor vehicles produced by any company in the world is a White achievement, the result of more than fifty years of practical manufacturing experience, and during all these years the name of White has been the guarantee of absolute responsibility and excellence of production.

White *Self-Starting* Forty Coupe

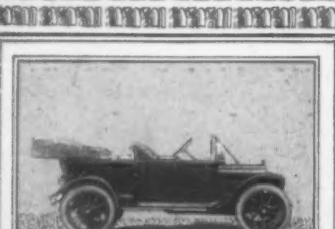
White One-and-One-Half-Ton Truck

White *Self-Starting* Forty Touring Car



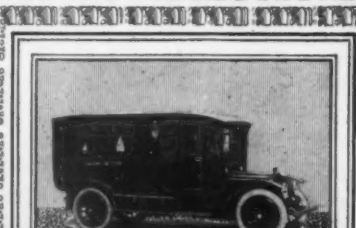
White Three-Quarter-Ton Truck

THE WHITE COMPANY
CLEVELAND



White *Self-Starting* Thirty Touring Car

White Five-Ton Power Dumping Truck



White Ambulance